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TELEVISION FOR HIGHER EDUCATION IN COLORADO--A FIVE-YEAR PLAN.

ASSOCIATION OF STATE INST. OF HIGHER EDUC. IN COLO

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THIS REPORT PRESENTS RESULTS OF AN 18-MONTH STUDY WHICH CONCLUDES THAT TELEVISION CAN BE USED IN COLORADO HIGHER EDUCATION TO INCREASE EFFICIENCY AND IMPROVE THE QUALITY OF INSTRUCTION. THE IMPORTANCE OF IMMEDIATE ACTION, TO MEET BUDGET DEADLINES, IS STRESSED. THE REPORT DEALS WITH FOUR INSTITUTIONS CURRENTLY USING EDUCATIONAL TV TO A LIMITED EXTENT. 5 TYPES OF EDUCATIONAL EFFICIENCIES DUE TO USE OF TV ARE REPORTED, ALONG WITH EQUIPMENT LEVEL AND INVESTMENT NECESSARY FOR EACH. THE TYPES CONCERN USE OF FACULTY, SPACE, EXCHANGE OF TV PROGRAMS AMONG CAMPUSES, ADULT EDUCATION, AND A STATEWIDE EDUCATIONAL NETWORK. THE NETWORK WOULD BE OPERATIONAL BY 1969-70, END OF THE FIVE YEAR PLAN. APPENDICES PRESENT INFORMATION ON FEDERAL FUNDING, COST-PER-STUDENT-PER-CREDIT-HOUR OF TEACHING VIA TV, AND FACTORS AFFECTING FEASIBILITY OF TV IN COLORADO. (LH)

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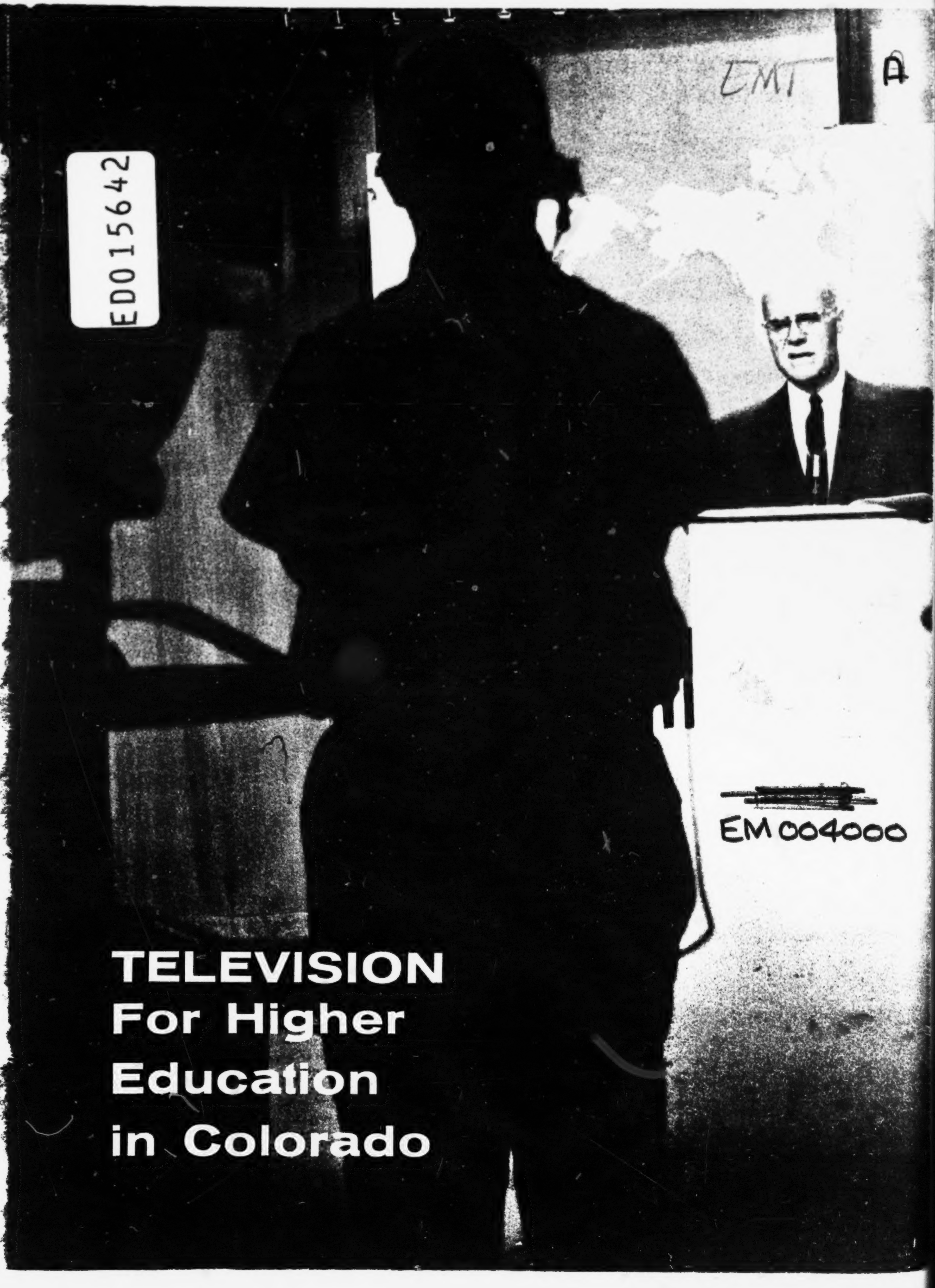

TELEVISION
For Higher Education in Colorado

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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TELEVISION
FOR HIGHER EDUCATION
IN COLORADO:
A FIVE-YEAR PLAN

ASSOCIATION OF STATE INSTITUTIONS
OF HIGHER EDUCATION IN COLORADO

July, 1964

EM 004 080

PREFACE:

On September 19, 1962, the Association of State Institutions of Higher Education in Colorado appointed an ETV Committee to consider ways and means of achieving cooperative action on educational television in higher education. Further, the Committee was given the charge "to recommend to the Association a coordinated plan for ETV in higher education in the State of Colorado".

The ETV Committee was composed of appropriate ETV representatives from each school represented in the Association. Ex officio members of the Committee were invited from the United States Air Force Academy, Denver University, and Station KRMA, Denver, all of whom have a vital interest in educational television in Colorado.

In December, 1962, TELEVISION FOR HIGHER EDUCATION IN COLORADO -- PRELIMINARY REPORT was submitted to the Association. This Report outlined the current status of ETV in Colorado, listed alternate ways of using ETV in higher education, and recommended that "each institution should develop an educational television 'task force' to study the needs for educational television on its own campus and develop plans accordingly"; that "a State-wide system of higher educational television should be established", and that "the current Educational Television Committee should continue its study and analysis of the use of television in higher education in Colorado".

The procedures recommended in this Report were accepted; each school in the Association developed internal "ETV Task Forces", and the Association's ETV Committee developed unified long-range plans for educational television in Colorado.

At the June 11, 1964, meeting, the Association of State Institutions of Higher Education in Colorado accepted and approved for release this Report on TELEVISION FOR HIGHER EDUCATION IN COLORADO: A FIVE-YEAR PLAN.

PREFACE (continued)

Institutional representatives on the Association's ETV Committee, 1962-1964 were:

Colorado State College---------Harold Bowman
Frank Jamison
Herman Williams

Colorado State University------Preston Davis
Herman Weisman

Southern Colorado State
College----------------------Gerald Caduff

University of Colorado---------Richard H. Bell, Secretary
Robert E. deKieffer, Chairman
James A. Dryden

Colorado School of Mines-------James G. Robinson
James Sankowitz

Adams State College------------Budge Threlkeld

Fort Lewis A & M College-------H. E. Owen

Western State College----------Ted Johnson

The Association----------------Harry Allen

Ex Officio Representation:

Denver University--------------Noel Jordan

Station KRMA, Channel 6--------James Case

United States Air Force
Academy----------------------Major Coit Butler
Captain John Haney
Major Arthur Steiger

Members of the State Report Sub-Committee were:

Richard H. Bell, Chairman
Gerald Caduff
Preston Davis
Frank Jamison

* * * * * *

CONTENTS:

Preface

Abstract of Report---------- 1

Recommendations---------- 12

TELEVISION FOR HIGHER EDUCATION IN COLORADO: A FIVE-YEAR PLAN

I. Introduction---------- 14

II. Educational Television History---------- 17

III. Underlying Assumptions---------- 20

IV. Improvement of Educational Efficiency and Effectiveness in Colorado Colleges Through the Use of Television---------- 21

V. Developmental Plan for Educational Television in Colorado Higher Education---------- 46

Appendices:

A. Factors Bearing on Effectiveness and Efficiency in Use of Instructional Television in Higher Education---------- 54

B. Summary: Status of Federal Funding for ETV, January 1, 1964---------- 62

C. A Study of Cost Per Student-Credit-Hour of Teaching via Television at the University of Colorado---------- 65

D. Possibilities for the Exchange of Courses and Resources Among Colorado Institutions via Television---------- 82

E. Colorado State Educational Television Network---------- 87

Glossary of Terms----------102

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TELEVISION FOR HIGHER EDUCATION IN COLORADO: A FIVE-YEAR PLAN

I. INTRODUCTION

This Report was prepared as the result of an eighteen-month study by the Association of State Institutions of Higher Education in Colorado.

The fundamental question with which this Report treats is:

> "Can television be used in Colorado higher education to increase efficiency and maintain or improve the quality of instruction?"

The answer to this question, which has been reached as the result of careful study and local consideration, is an affirmative one. The Association is in agreement that, if intelligently and carefully used, television can increase the efficiency and improve the quality of instruction in Colorado's State colleges and universities. Failure to make immediate and effective use of television in higher education would be to neglect a powerful new medium of education at a time when it is critically needed.

The Report is based on national and local studies which indicate that television is a proven and useful medium of instruction, and experience in this State which indicates that it should be more widely used in Colorado higher education.

Steps to use television in Colorado must be based on a coordinated, long-range plan in order to avoid needless duplication of effort and purchase of incompatible equipment. Although no joint budgeting is recommended, funding of educational television on each campus through individual budgets should proceed as scheduled in this Report, if the maximum benefits of ETV are to be realized.

It is important for this Report to be considered and implemented in the immediate future because of several time factors. Under PL 87-447, the Educational Television Facilities Act, $663,393 in Federal funds are available to Colorado on a matching basis for the construction of educational television stations. Application for such funds must be submitted prior to July 1, 1968. If Colorado institutions are to activate ETV stations (as is recommended in the Report), these funds will greatly reduce the cost of such activation. Because of lead time necessary for budgeting and implementing programs in higher education, plans for ETV development should be formulated and approved at once.

ABSTRACT (continued)

It is clearly recognized by the Association that as ETV for higher education develops into the broadcasting area, the public elementary and secondary schools of the State will be vitally concerned, and should be involved in the overall planning. Currently, there is public school ETV activity in many parts of the State, and appropriate public school agencies and individuals should be involved immediately in plans for a State-wide ETV network.

In scope, this Report deals primarily with four institutions -- Colorado State College, Colorado State University, Southern Colorado State College, and the University of Colorado, as these four institutions currently are actively engaged in programs of ETV, and their future developments in this area will be crucial to any over-all system of ETV for higher education in the State.

In this Report, five major types of educational efficiencies which can be realized by the use of television are shown. Each type assumes a certain equipment level. These levels are:

Campus Level	Primarily for conducting academic course work on individual campuses. Needed: Studios, control room, video-tape recorder, a campus closed-circuit distribution system, and 600 student viewing stations. Investment: Approximately $100,000 per institution.
Inter-Campus Exchange Level	Primarily for the exchange of academic course work among Colorado institutions and others. Needed: Campus level equipment that is compatible. Additional Investment: None.
Expanded Campus Level	Primarily for extending campus distribution systems to cover multi-campuses and dormitories. Additional Investment: Approximately $50,000.

Broadcast Level-------------	Primarily for conducting adult and extension education over a wide area. Needed: Transmitter, tower, antenna and studio-transmitter link. Additional Investment: Approximately $150,000 per station in local funds, plus approximately $200,000 in Federal funds.
State-Wide Level-------------	Primarily to extend educational resources to all schools and communities in the State. Additional Investment: Approximately $525,000 for a State-wide network.

II. AREAS OF EFFICIENCY

The following areas of educational efficiency and effectiveness are studied in this Report:

A. Improved Efficiency in Use of Faculty Personnel (Campus Level)

Projected enrollments for the four institutions reveal an increase from 27,835 in 1963 to 45,279 in 1971 -- an average increase of 55%.

Meeting this enrollment growth will require increases in number of faculty, possible increase of faculty teaching loads, and the use of television to enable faculty members to teach larger numbers of students without excessive increase in teaching load. By the latter means, a professor can lecture a group of 600 via television as effectively as he can lecture a group of 200 in a classroom.

By having one professor lecture large, multi-section courses via television, taping the lecture, and playing the tape for additional sections, he can have more time to prepare lectures, to teach other courses, to work with individual students, or to do research.

This type of teaching lends itself to courses in which there are 400 students or more enrolled per semester, with over 2 sections of the course with over 50 students per section. There are 36 such courses on the four campuses at present, and prospects are for an increase in that number.

The Education Department at SCSC has stated that: "If the Department were provided the use of the necessary television equipment, including a video-tape recorder and reviewing areas, the existing staff would be adequate for next year (1964-1965) except for supervisory personnel."

Experience has shown that when class size reaches 200 to 350, students can be taught via television at a lower unit cost than they can by conventional methods. The variation in this "break-even point" is caused by differences in institutional goals, policies, type of equipment and other variables.

In Summary, the efficiencies realized are:

1. Repetition of lectures is avoided, providing more time for preparation, teaching other courses, research, or other academic activity.

2. As enrollments in large, multi-section courses go up, unit cost of teaching these courses via television goes down.

3. By re-using taped portions of courses in subsequent semesters, both time and money are saved.

4. Additional students can be taught without overloading the professor.

5. The professor's productivity is increased, and his value to the institution is enhanced.

B. Improved Efficiency in Use of Campus Space (Expanded Campus Level)

There are three areas of consideration here:

1. Increases in enrollments will necessitate the most effective possible use of existing and future instructional space.

   Television installations in auditoria can increase their usefulness as instructional areas (since viewing is better than if all students are watching one professor in the auditorium).

   Twenty 30-seat classrooms would hold 600 students, all of whom could be taught by the same professor at a given time.

2. Students can view educational television programs in the residence halls. Within the next five years, approximately one-third of the students at each school will be living in campus housing. Closed-circuit television in the dormitories would provide for direct teaching, examination reviews, special enrichment material, student orientation, and "how to study" courses.

   If broadcast is used, these same resources can reach every student housing area in the community, including fraternity houses, sorority houses, and other off-campus dwellings.

3. Each campus under consideration has multiple campuses with attendant problems of making resources available on all of them. Through the use of closed-circuit cables, fixed television service, micro-wave relays, and/or broadcast television, each campus can receive the resources of the other.

   In Summary, the efficiencies realized are:

   1. More efficient use is made of existing space through flexibility provided by closed-circuit television.

   2. Dormitories and other housing areas are available for teaching via television.

   3. Savings can be realized on teaching students on separated campuses simultaneously, without duplication of resources and facilities.

C. Exchange of Television Programs Among Institutions of Higher Education to Avoid Duplication of Resources, Facilities and Personnel
(Inter-Campus Exchange Level)

Both within the State (as exemplified by the Association), and within the region (as exemplified by the Mid-America State University Association), there is an interest in sharing resources in order to avoid the cost of duplicate facilities in many areas.

By exchanging resources via video-tape recorder, many unique resources can be exchanged. Exploration on each of the campuses reveals a long list of courses and resources which might be exchanged to mutual advantage.

Nationally, there are now 324 courses on tape or film available for broadcast and closed-circuit use. Of especial relation to this Report are the 52 college courses, and 43 adult education courses.

Regionally, a sub-committee of the Mid-America State University Association is considering a proposal for a feasibility study on inter-state exchange of resources via television.

In Summary, the following efficiences realized are:

1. Resources not normally available at every institution can be made available at reasonable cost.

2. The cost avoidance stemming from not having complete resources of human knowledge on every campus is considerable.

3. The specialized personnel, facilities, and resources of one institution can be used more efficiently by serving the educational needs of more people, and can help one state build up credit for obtaining resources from other states.

D. Extension of Education Resources Beyond the Campus
(Broadcast Level)

There are critical needs in Colorado for adult education,

education for school drop-outs, education for the able and ambitious high school student (one-third of Colorado's high schools make no provision for this), remedial programs for slow learners, and special education for various specialized professional groups. Broadcast ETV provides the most efficient and effective means of reaching these various and varied groups.

By activating Channel 12 in Boulder, at a cost to the State of $151,000 (matched by $206,000 of Federal funds under PL 87-447), and Channel 8 in Pueblo, at a cost of $200,000 in State funds, and $200,000 in Federal funds, 88% of the State's population could be covered by educational television.

These stations would be jointly programmed (Channel 12's transmitter would be located so that there could be a direct connection between the transmitter and studios at CU, CSU and CSC) by the institutions of higher learning, and the public schools covered by the station. Funding for basic operation of the station would be to the licensee (University of Colorado for Channel 12; Southern Colorado State College for Channel 8), with programming funds budgeted to the institutions on the basis of the amount and type of programming they were undertaking.

As an illustration of the low unit cost of broadcast education, a hypothetical educational television station, operating on an annual budget of $330,000, programming only 20 hours a week, 52 weeks of the year, to an average audience of only 1,000 persons is providing education ata cost of 31¢ per exposure hour -- a reasonable price for education in an age of which Alfred North Whitehead said:

> "Tomorrow, science will move forward yet one more step, and there will be no appeal from the judgement which will then be pronounced on the uneducated."

In Summary, the efficiencies realized are:

1. Establishment of low unit cost type of adult education, continuing education, vocational education,

special education, remedial education, and education for exceptional children, through the cooperative establishment of a "University of the People".

2. Closer coordination and great efficiency in extending extension efforts of the schools.
3. Avoidance of the cost of an uneducated population.

E. Equilization of Education Through a State-Wide System (State-Wide Network Level)

There is a need, recognized in the Small Schools Project currently being carried on by the State Department of Education, to provide improved educational resources for many small schools in Colorado.

The development of junior colleges throughout the State will require the marshalling of all available educational resources, particularly in the early developmental stages of these schools.

Through the use of micro-wave relays, the State's three educational VHF channels -- 6 in Denver, 8 in Pueblo, 12 in Boulder -- could be linked. Through the use of translators, micro-wave links, educational broadcasts could be brought to every community in the State through the Colorado Educational Television Network.

Considerable savings ($260,000) could be realized by making use of the State Patrol's existing sites and towers, mounting on them the electronic equipment needed to relay ETV programs to areas throughout the State.

A Cooperative Programming Board would plan over-all exchange of programs for all levels of education throughout the State. Meanwhile, individual colleges and universities would still be meeting their local needs through closed-circuit and/or broadcast.

In Summary, the efficiencies realized are:

1. Enrichment of the educational facilities of public schools, junior colleges, and State institutions of

higher learning in the State of Colorado could be effected in the most economical way, through the establishment of The Colorado Educational Television Network.

F. Additional Values of Educational Television

In addition to the major efficiencies noted, the following values of ETV facilities should be taken into account:

1. Instruction in courses in broadcasting, journalism, electronics, and other technical subjects.
2. Use of television facilities as research tools in technical, sociological, and psychological areas.
3. Use of television as a teaching tool for magnification in the classroom.
4. Video-tape recording as a means for student self-evaluation in skills courses.
5. Remote observation of elementary and secondary level classrooms by students enrolled in teacher training curricula at the various colleges and universities.
6. Use of television for centralized film distribution to provide films for classrooms whenever needed.
7. Use of broadcast television as a means of better acquainting the public with the objectives and problems of higher education.

III. SUMMARY OF DEVELOPMENTAL PLAN FOR EDUCATIONAL TELEVISION IN COLORADO HIGHER EDUCATION

	CSC:	CSU:	SCSC:	CU:
1964-65	Campus Level Inter-Campus Exchange Level	Developmental	Campus Level Inter-Campus Exchange Level	Campus Level Inter-Campus Exchange Level
1965-66	Expanded Campus Level Inter-Campus Exchange Level	Campus Level Inter-Campus Exchange Level	Expanded Campus Level Inter-Campus Exchange Level	Broadcast Level Channel 12
1966-67	Broadcast Level Channel 12	Broadcast Level Channel 12	Expanded Campus Level Inter-Campus Exchange Level	Broadcast Level Channel 12
1967-68	Continued Broadcast Level	Continued Broadcast Level	Broadcast Level Channel 8	Continued Broadcast Level

Development of West Slope Schools for Exchange of Programs.

1968-69 Linkage of Channel 8 with Channels 6 and 12, and West Slope Schools Exchange.

1969-70 State-Wide Level Throughout Colorado.

IV. CONCLUSION

If Colorado is to make educational use of the television medium to realize greater efficiency and effectiveness in higher education, it is necessary that steps be taken now. This Report is written in the sincere hope that it will provide, not a fixed mold into which to force all future ETV development in the State, but a guide to encourage and coordinate the planning, financing, and implementation of educational television in Colorado.

RECOMMENDATIONS:

In light of the facts and opinion presented in this Report, the Association of State Institutions of Higher Education in Colorado makes the following recommendations:

1. That this Report be used as a guideline for the development of ETV on campuses of state institutions of higher education.
2. That the respective Boards of Control request the funding necessary to maintain this development plan on schedule, and that inclusion of necessary budgeting to implement this plan should begin in the 1965-1966 budgets.
3. That the ETV Committee serve as the coordinating agency for educational television in state institutions of higher education in Colorado.
4. That the ETV Committee invite a representative of the Colorado Junior Colleges to join this Committee, so that it may more fully represent public higher education in Colorado.
5. That the ETV Committee prepare a proposal for the inclusion of key elementary and secondary school representatives in the Committee, so that the planning for broadcast ETV in Colorado can be thoroughly integrated.
6. That the state colleges on the Western Slope begin specific planning for their development of ETV in order to phase in with this developmental plan.

I. INTRODUCTION

A. Basic Questions

Repeatedly, state administrators, including the governor, have indicated that Colorado institutions of higher education must explore the use of new media, especially educational television, to meet the problems of education in the State, and to make "best use of available funds".

Simultaneously, faculties and administrations of Colorado institutions are seeking new methods of improving the quality of instruction in the face of increasing enrollments and expanding fields of knowledge.

A fundamental question being raised for Colorado higher education then, is:

> "..can television be used in Colorado higher education to increase efficiency and maintain or improve the quality of instruction?"

It is to this question that this Report addresses itself.

The answer to this question, which has been reached as the result of careful study and local consideration, is an affirmative one. The Association is in agreement that, if intelligently and carefully used, television can increase the efficiency and improve the quality of instruction in Colorado's State colleges and universities. Failure to make immediate and effective use of television in higher education would be to neglect a powerful new medium of education at a time when it is critically needed.

B. Pertinent Factors

Several factors are fundamental to any consideration of this question. One is an assumption that educational television is a proven medium for educational efficiency and effectiveness. Rarely has a new educational device been so thoroughly researched so quickly. In general, the findings of the research are positive. A summary of some of this research is found in Appendix A -- Factors Bearing on Effectiveness and Efficiency in Use of Instructional Television in Higher Education, by Richard H. Bell.

Secondly, the desire for coordination and differentiation of functions among the State-supported institutions of higher education in Colorado, as reflected in the Association's Program published in December, 1962, indicates that any planning for the use of ETV in Colorado should be done on an inter-institutional basis. Each institution of higher education will continue to develop its own plans for educational television, and submit its own budget, but such planning will be done in cooperation and consultation with the other schools.

This coordination is particularly important in the development of television, where technical equipment is involved. Currently, there are four portable video-tape recorders on the market. Each is incompatible with all others. If the schools in Colorado obtain the same type of video-tape recorder, they can exchange educational resources via video-tape -- if not, the machines will be worthless for this purpose. Also, the activation of an ETV station on Channel 12 would provide the broadcast outlet for Colorado State College and Colorado State University, as well as the University of Colorado, and, again, joint planning is indicated.

It is clearly recognized that as ETV for higher education develops into the broadcasting area, the public elementary and secondary schools of the State will be vitally concerned, and should be involved in the overall planning. Currently, there is public school ETV activity in many parts of the State, and appropriate public school agencies and individuals should be involved immediately in plans for a State-wide ETV network.

C. Scope

This Report deals primarily with four State institutions of higher learning in the Eastern part of Colorado -- Colorado State College, Colorado State University, Southern Colorado State College, and the University of Colorado. This limitation is imposed, not from any illusion that these institutions are totally representative of higher education in this State, but because:

1. As an ETV Committee of the Association of State-Supported Institutions of Higher Education, this Committee currently is not authorized to deal with elementary and secondary education television planning.

2. Currently, the junior colleges and the four-year State

schools on the Western Slope are in the earliest planning stages regarding ETV, and to some extent, they are looking to action by the four schools in this Report as a guide to their future activity.

3. Action by the four schools in this Report is critically and urgently needed in order to move forward in Colorado ETV, and in order to activate the two remaining VHF channels reserved for education in Colorado.

D. Urgency

Timing is critical in the development of ETV in Colorado. Because educational budgets are prepared over a year in advance, and because future developments must be seen clearly in order to plan intermediate steps without wasted effort, unnecessary expenditures, and duplicated activity, it was deemed imperative that this Report encompass a five-year period, from the next budget, 1965-1966, to the fiscal year of 1969-1970.

Also, the availability of Federal funds under PL 87-447 for the next four years (until July 1, 1968) provides an incentive for immediate planning insofar as the activation of any ETV broadcast stations are concerned. (See Appendix B -- Summary: Status of Federal Funding for ETV, by Richard H. Bell).

If television has any value for Colorado higher education (which this Report hopes to prove), then it is important that it be given a high priority in college and university planning and budgeting. Each institution should proceed with budgeting and funding for ETV on its own campus on the schedule outlined in this coordinated plan, if the maximum benefits of ETV are to be realized.

In light of these facts, this coordinated, long-range plan for ETV in Colorado was prepared, based on a consideration of how television can best be applied to higher education to increase efficiency and effectiveness while maintaining or improving the quality of education at these schools.

II. EDUCATIONAL TELEVISION HISTORY

A. Nationally

Since 1952, the number of educational television stations on the air has risen from none to 90 stations in 37 states.

Closed-circuit television installations in educational institutions currently number over 600.

There are 324 complete credit courses available on video-tape and film -- 52 at the college level; 43 in adult education; 10 in-service training courses; the remaining 219 at elementary and secondary level.

The Midwest Program on Airborne Television Instruction broadcasts ETV programs from an airplane to students in 2,300 schools in six states.

NET, the national educational television programming service, provides ten hours per week of educational programming to educational stations affiliated with it.

B. Regionally

In some states in the Mountain-Plains area, educational television has made rapid strides:

> Three ETV stations are operated by institutions of higher education in Utah.
>
> Oklahoma has state-wide ETV coverage.
>
> New Mexico has been granted funds for additional ETV stations to provide wider coverage of their state.
>
> The Nebraska legislature has authorized construction of a state-wide network of educational television stations.

C. Colorado -- General

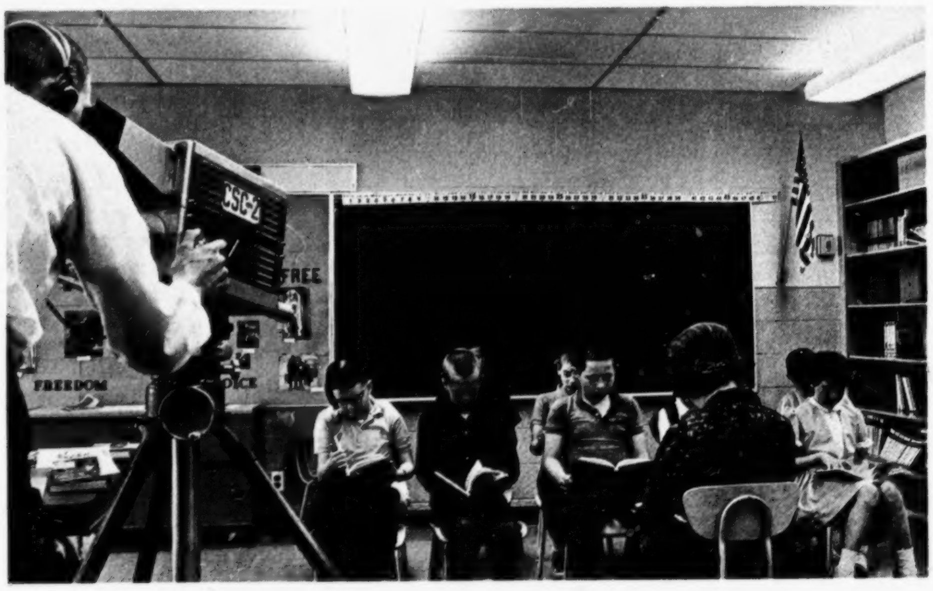
Station KRMA, Channel 6, Denver, is a well-established, nationally-known ETV station.

United States Air Force Academy is making wide use of closed-circuit television, and is attracting national attention with this experimentation.

Denver University has fully equipped television studios, and is teaching university courses over closed-circuit television.

D. Colorado -- State Institutions of Higher Education

COLORADO STATE COLLEGE has completed new studios and control room in its Laboratory School, and is using television for classroom observation and for televised teaching over a closed-circuit distribution system--a typical classroom observation scene is shown below:



COLORADO STATE UNIVERSITY is planning to integrate television into the Audio-Visual Services in existing film and recording studios -- and currently is broadcasting many educational programs over commercial television stations. Below, the film studio is pictured:

(MORE)

SOUTHERN COLORADO STATE COLLEGE has a completely equipped studio and control room, and is using television as a centralized distribution system for films, as well as for telecourses. The facility is pictured below:

The UNIVERSITY OF COLORADO has a completely equipped broadcast studio and control room, with a video-tape recorder, and micro-wave link to the Denver Extension Center. Courses are being taught over the campus closed-circuit system, and to the Denver Center. Television is also being used on-campus for magnification and observation. Pictured below -- the video-tape recorder:

A beginning has been made with the use of television in education in Colorado State institutions of higher learning, but, as yet, television has not become a major instrument of instruction which it can be.

(MORE)

A. Television is a unique teaching tool, which results in many educational advantages when properly used. It combines the immediacy of radio, the visual impact of films, the information storage and retrieval of books.

B. The uses of television in education are many and varied, as is television equipment. Proper use assumes careful selection of the right type of television equipment for the intended use.

C. Television is an established, proven teaching medium. Thorough research proves that important types of learning can take place via television: information gain and retention is good, students can be motivated by television, the teaching of visual skills takes place readily, effective lecturing is facilitated, and outside resources are brought into the classroom.

D. Correctly used in the teaching of large numbers and by linking schools, TV can help solve some of the educational problems in Colorado, and do so at reasonable cost.

E. Television can relieve the teacher of responsibility for information storage and retrieval, freeing him to carry on the task of interpreting, adapting, stimulating thinking, and creating a learning climate -- tasks which only he can do.

F. More efficient and effective use of television in higher education can be realized if all State institutions budget and fund their individual ETV development on a coordinated State-wide schedule for ETV in Colorado higher education.

IV. IMPROVEMENT OF EDUCATIONAL EFFICIENCY AND EFFECTIVENESS IN COLORADO COLLEGES THROUGH USE OF TELEVISION

In this section of the Report, five major types of efficiencies realized by the educational use of TV are listed and discussed. In each is shown:

1. Need for such efficiencies.
2. Application of television.
3. Feasibility.
4. Comparative costs.
5. Efficiencies realized.

In order to have a basis for comparing costs, we will assume five progressive levels of equipment and operation development. They are as follows:

Campus Level-----------------Primarily for conducting academic course work on individual campuses.
Needed: Studios, control room, videotape recorder, a campus closed-circuit distribution system, and 600 student viewing stations.
Investment: Approximately $100,000 per institution.

Inter-Campus Exchange Level------------------------Primarily for the exchange of academic course work among Colorado institutions and others.
Needed: Campus level equipment that is compatible.
Additional Investment: None.

Expanded Campus Level--------Primarily for extending campus distribution systems to cover multi campuses and dormitories. Additional Investment: Approximately $50,000.

Broadcast Level--------------Primarily for conducting adult and extension education over a wide area.
Needed: Transmitter, tower, antenna and studio-transmitter link.
Additional Investment: Approximately $150,000 per station in local funds, plus approximately $200,000 in Federal funds.

State-Wide Level------------Primarily to extend educational resources to all schools and communities in the State.
Additional Investment: Approximately $525,000 for a State-wide network.

It should be noted that the figures above are highly generalized, and that actual costs for any ETV operation must be based on the use to which it is to be put, and the specific equipment which is dictated for this use.

The following five categories indicate types of effeciencies which can be realized through use of television:

A. Improved Efficiency in Use of Faculty Personnel

Need----Projected enrollment figures by the Committee for Education Beyond High School indicate the following growth in student population:

	Actual 1963	Projected 1971	Increase
CSC	4,881	8,510	74%
CSU	8,460	14,235	68%
SCSC	1,956	4,991	155%
CU	12,538	17,543	40%
TOTAL	27,835	45,279	

In light of these projected increases, it can be assumed that a combination of the following steps will need to be taken:

a. Add proportionate number of faculty to maintain present faculty teaching loads.

b. Increase faculty teaching loads beyond present total teaching hours.

c. Increase the number of students taught by faculty in current number of teaching hours through use of television.

2. Television Application (campus level)----If a professor's average teaching load is 9 hours, a student increase of even 25% without appropriate faculty increase would raise teaching loads to 12 hours; if load is 12 hours, it would be raised to 15 hours.

If, in large, multi-section courses, the professor's lectures can be extended to the 25% increase in students, he can maintain his load at existing levels, lecture 125 or 400 students with as much effectiveness as he now lectures 100, and increase his economic value to the institution because his output is greater.

The following chart illustrates how this could be done:

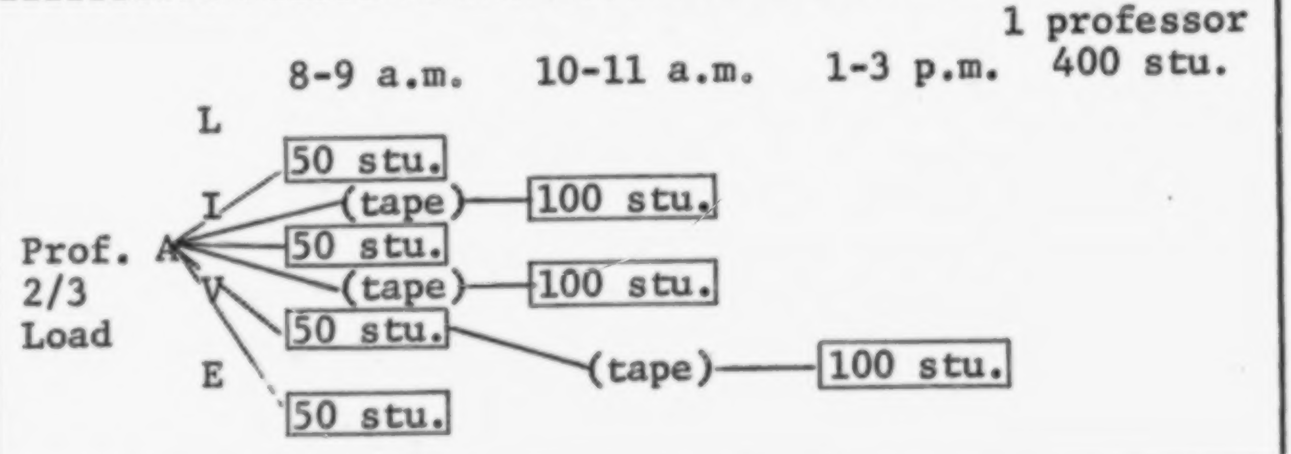
TABLE I:

CONVENTIONAL INSTRUCTION

2 professors
200 stu.

	8-9 a.m.	10-11 a.m.	1-3 p.m.	3-5 p.m.
Professor A -- Full Load $10,000				
Course X	50 stu.	50 stu.	50 stu.	50 stu.
Professor B -- Full Load $10,000				
Course X	50 stu.	50 stu.	50 stu.	50 stu.

TELEVISION INSTRUCTION


1 professor
400 stu.
8-9 a.m.
10-11 a.m.
1-3 p.m.
L
I
V
E
Prof. A
2/3
Load
50 stu.
(tape)
100 stu.
50 stu.
(tape)
100 stu.
50 stu.
(tape)
100 stu.
50 stu.

In the conventional situation, two professors are occupied full-time with teaching 200 students. With television, Professor A gives the lecture once and reaches 400 students. He is given double credit on his teaching load to prepare, so that he can do the best job possible. He still has half of his time for other academic work.

Professor B is freed for teaching other courses, working with individual students, doing research, or improving his instruction.

In subsequent semesters, taped lectures which are still valid may be replayed, rather than taking professional time for live lectures.

3. Feasibility-----Only certain courses lend themselves to mass teaching as suggested above. On the assumption that a mass teaching situation exists in any course which has:

a. Over 400 students per semester enrolled;

b. Over 2 sections of the course;

c. Over 50 students per section,[1]

these criteria can be used to determine the number of courses which might be suitable to presentation over television.

Courses fitting these criteria exist on the following campuses in the following numbers:

Colorado State College----------- 13 courses
Colorado State University-------- 11 courses
Southern Colorado State College-- 2 courses
University of Colorado----------- 10 courses

If these lecture courses were taught via television with video-taped repeats, greater effectiveness and efficiency in education could be achieved.

---

[1] From Educational Television in the Leading Universities of the United States, J. G. Paltridge, University of California, 1962.

Further, these are conservative criteria, and experience shows that in many situations, somewhat smaller courses can be taught economically via TV. It should be noted also that enrollment projections indicate that the number of such courses will increase in the next five years.

Bearing directly on this position, the following statements were made by the Education Department of SCSC, where student body size is the least pressing:

> "Out of the 72 failures during the Fall quarter of the 1963-1964 year, 30 per cent could have passed if they could have had additional help via video-taped lectures. Since the lectures would already be prepared on tape, additional receiving times could be scheduled during out-of-class hours in the day for student help. A possible saving of sixty students per year is apparent.
>
> Three classes of 130, 130 and 60 could be taught via VTR lectures in Philosophy of Education, Ed. 222. These could be met at one hour in multiple classrooms, or at different hours. In either case, there would be a saving of time, space, and instructors' time. General Psychology 102 could be accommodated in two lectures (400-450) by the use of multiple rooms with VTR. Greater uniformity of instructor would be an additional quality factor gained, especially if the concept of team-teaching were employed.
>
> It is felt that ETV can do the following for the Department:
>
> 1. Produce better instruction by better lectures and visibility of presented materials.

2. Existing staff can handle load next year providing a measure of cost avoidance.

3. Standardized lectures for all groups by the use of the same material for each group.

4. Team-teaching could provide for the presentation of the strong area of each instructor to all classes.

5. Provide for more valid departmental examinations due to standardization.

If the Department were provided the use of the necessary television equipment, including a video-tape recorder and reviewing areas, the existing staff would be adequate for next year, except for supervisory personnel."

4. Comparative Cost--------Various studies indicate that the cost of instruction via television moves below that of conventional instruction when classes of from 200 to 300 students are being taught. (The variation comes from the nature of the specific situation, equipment, etc.) A survey made at the University of Colorado indicates that classes of over 334 students can be taught more economically via television than by conventional means. (See Appendix C -- A Study of the Cost Per Student-Credit-Hour of Teaching Via Television at the University of Colorado, by Richard H. Bell.)

At the University of Colorado, cost per student-credit-hour for lower division courses in 1961-1962 was $10.91. Cost of teaching three three-hour courses per semester on the CU television system with 600 student stations would come to $10.74 per student-credit-hour. As number of students increases, cost per student-credit-hour via television decreases.

In analyzing television teaching costs, Donald W. Paden, Professor of Economics at the University of Illinois, states:

> "...instructional television compares favorably with conventional large lectures on a cost basis when the number of students becomes so large that the usual conventional lecture needs to be repeated. The favorable comparison is possible however, only if a relatively large portion of the television lectures can be re-used in subsequent periods."

5. Efficiencies Realized-----a. Repetition of lectures is avoided, providing more time for preparation, teaching other courses, or research, or other academic activity.

   b. As enrollments in large, multi-section courses go up, unit cost of teaching these courses via television goes down.

   c. By re-using taped portions of courses in subsequent semesters, both time and money are saved.

   d. Additional students can be accommodated without over-loading professor.

   e. Professor's productivity is increased, and hence, his economic value is enhanced.

B. Greater Efficiency in Use of Campus Space

1. Need---------a. Current national college enrollment of 3.5 million will reach 7 million by 1970. Construction of facilities for institutions of higher education to meet this growth will require $2,300,000,000 per year. Colorado's share of this increase will require ever-increasing amounts of classroom space. If increased use of existing space can be made, the need will not be as great, and the cost of construction will not be as high.

   Type of space often is a problem, with many large (300 seat) lecture auditoria sitting idle at some hours, while there is a heavy demand for them at other hours.

b. Dormitories occupy a large amount of current campus space, and are occupied for many hours of the students' college life.

c. Divided campuses for all four schools present problems of having space in the wrong locations, of forcing students and faculty to move rapidly from one area to another, and of duplicating facilities. Examples are as follow:

CSC-------Three campuses.
CSU-------Foothills Campus 3 miles from main campus.
SCSC------Will be a two-campus institution as they make the transition from the Pueblo Junior College campus to the new SCSC campus.
CU--------Denver Extension Center, Colorado Springs Extension Center, Medical School, and Boulder campus, widely separated.

2. Television Application (expanded campus level)-------a. Flexibility in the use of existing space can be increased through the use of television. Twenty thirty-seat classrooms would hold 600 students, all of whom could be attending the same lecture via television. This would be particularly advantageous if there were to be small group discussions immediately following the general presentation. (See Table II)

TABLE II:
SAMPLE TELECOURSE TRANSMISSION SCHEDULE

(These are subjects arbitrarily selected from those courses which usually have large enrollments. Specific courses and numbers of repeats would depend largely on situation on each campus and adaptability of course to effective television presentation.) (Underlined sections are video-tape repeats.)

	Monday:	Tuesday:	Wednesday:	Thursday:	Friday:
8:00	Biology	Geology	Biology	Geology	Biology
9:00	Biology	Geology	Biology	Geology	Biology
10:00	Economics	Chemistry	Economics	Chemistry	Economics
11:00	Economics	Chemistry	Economics	Chemistry	Economics
12:00	----------	----------	----------	----------	----------
1:00	Education	Psychology	Education	Psychology	Education
2:00	Education	Psychology	Education	Psychology	Education
3:00	Anthropology	History	Anthropology	History	Anthropology
4:00	Anthropology	History	Anthropology	History	Anthropology
5:00	Biology	Psychology	Biology	Psychology	Biology
6:00	Economics	History	Economics	History	Economics
7:00	Community programs if a broadcast operation.				
8:00	Academic enrichment programs if closed-circuit.				
9:00	Education	History (earlier lesson)	Education	History (earlier lesson)	Education
10:00	Anthropology	Psychology (earlier lesson)	Anthropology	Psychology (earlier lesson)	Anthropology

1. Lectures are given once per week, repeated on tape for classroom and/or dormitory viewing or reviewing.
2. Eight large courses are presented with one lecture each and maximum flexibility is use of large and small classrooms and dormitory viewing rooms.
3. Late evening courses could be repeats of earlier lectures, for benefit of students who had missed them or wished to review them.

For large crowds, over-flow audiences for a talk or presentation can be seated in other auditoria, with closed-circuit television feeding the program to other centers, thus making better use of the auditoria.

b. Equipped with closed-circuit or broadcast receivers, dormitories could become areas in which students could be reached with educational resources.

Numbers of students who could be reached in dormitories are as follow:

	1963:	Future:
CSC	1,714	6,416
CSU	3,171	4,951
SCSC	0,000	1,617
CU	4,214	38% of single students; 25% of married students.

Within the next five years, approximately one-third of the students at each school could be reached in campus housing via closed-circuit television.

If a broadcast station on Channel 12 is utilized in Boulder, all student housing in Boulder, on-campus and off-campus, could be reached via television. In 1963-1964, this would have included 1,592 in fraternities and sororities; 12,538 in private homes.

Such an approach pre-supposes a willingness to use a variety of teaching patterns in modern education, combining lectures, discussion, and independent study in various formats. Fo sample freshman schedule, see Table III.

Use of 2,000 megacycle fixed service would enable direct transmission to given residence centers off-campus, as well.

c. Closed-circuit (via cable, or 2,000 megacycle or (micro-wave, such as CU currently is using or low-power broadcast, can bring the faculty resources, and facilities of one campus to se eral campuses.

TABLE III:

SAMPLE FRESHMAN SCHEDULE

	Monday:	Tuesday:	Wednesday:	Thursday:	Friday:
8:00	-------	Geology (TV Classroom)	Psychology (Discussion)	Geology (TV Classroom)	------
9:00	-------	Geology Lab	Psychology (Discussion)	Geology Lab	------
10:00	Econ. 201 (TV auditorium)	Geology Lab	Econ. 201 (TV auditorium)	Geology Lab	Econ. 201 (TV auditorium)
11:00	-------	-------	-------	-------	-------
12:00	-------	-------	-------	-------	-------
1:00	-------	Psych. 201 (TV dorm)	English	Psych. 201 (TV dorm)	------
2:00	-------	-------	-------	-------	-------
3:00	-------	English (Class)	P.E. (Class)	English (Class)	------
4:00	-------	-------	-------	-------	-------
5:00	-------	-------	-------	-------	-------
6:00	-------	-------	-------	-------	-------
7:00	-------	-------	-------	-------	-------
8:00	-------	-------	-------	-------	-------
9:00	------	English Suppl. (TV dorm)	--------	History Suppl. (TV dorm)	-------

TABLE III: (continued)

Geology 101------4 hours----(2 hrs. television lecture; 4 hrs. lab)
Psychology 201---4 hours----(2 hrs. TV lecture; 2 hrs. classroom disc.)
Economics 201----3 hours----(3 hrs. television lecture)
English 101------4 hours----(2 hrs. class disc.; one hour with instructor on tutorial basis; one hour supplemental viewing

Physical Educ.---1 hour-----
TOTAL 16 hours

Space needs for teaching 600 students with this schedule:

20----30-seat classrooms twice a week (Geology)------------2 hrs/wk
2----30-station Geology Labs, 20 times wk. (Psychology)--40 hrs/wk
5----30-seat classrooms, 4 times per week-----------------8 hrs/wk
20----30-seat classrooms, 2 times per week (English)------40 hrs/wk
2---300-seat auditoria, 3 times per week (Economics)------6 hrs/wk

PE facilities -- Library facilities -- Dormitories.

3. Feasibility-----a. The effective use of television for greater classroom efficiency depends on the specific classroom and space problems. The average usage of existing classroom space -- 28 hours per week -- may be increased by the flexibility provided by ability to televise courses into rooms of all sizes -- especially since tapes of lectures could be available at all hours.

b. Existing and needed material which could be fed into dormitories includes:

1. Direct teaching.
2. Examination review.
3. Special enrichment material.
4. Student orientation.
5. "How to Study" courses.
6. Special student performances.

c. Professors can readily reach a distant campus via television (as is being done by Dr. C. A. Hutchinson of the University of Colorado, who teaches Applied Math at the Denver Extension Center from the University); as can resources such as the Cyclotron, Alpine Research Center, classroom observation, etc.

The micro-wave from the Boulder campus to the Denver Extension Center gives a concrete example of how television can link two or more separated campuses.

4. Comparative Costs-----------Once a closed-circuit distribution system is established, rooms can be added at a maximum cost of $250 per 30 student viewing stations.

Projected enrollment increases dictate an increase in assignable square footage which may not be achieved soon enough in light of budgetary limitations.

By making maximum use of every existing room, the number of additional classrooms which will need to be constructed may be reduced. Additional buildings can be used more for specialized academic rooms, and less for standard lecture rooms.

Greater flexibility of presentation of lectures (because of taping and widespread distribution system) allows for greater efficiency of space utilization.

5. Efficiencies and Effectiveness---a. More efficient use is made of existing space through flexibility provided by closed-circuit television.

   b. Fewer general classrooms need to be built, if space in dormitories and other housing areas is available for teaching via television.

   c. Savings can be realized on teaching students on separated campuses simultaneously, without duplication of resources and facilities.

C. Exchange of Television Programs Among Institutions of Higher Education to Avoid Duplication of Resources, Facilities and Personnel

1. Need-----------"Coordination and joint planning among the institutions of public higher learning in Colorado are important in deriving maximum use of all the educational facilities and resources ... A major consideration is the increasing shortage of qualified faculty personnel."

This quotation from the Program for the General Differentiation and Coordination of Functions Among the State-Supported Institutions of Higher Education in Colorado, December, 1962, highlights the importance of coordinating the functions of higher education.

On the basis of the above quoted report, plus further evidence in the 2 years since its writing, it is obvious that economies can be realized, or costs avoided, if there is a high degree of coordination among schools, and little duplication of function.

Beyond the State limits, the existence of organizations such as the Mid-America State University Association points up the importance of cooperation among colleges and universities on an inter-state basis.

2. Television Application (inter-campus exchange level)----------Within the State, individual resources and/or entire courses could be exchanged among the State institutions of higher education in order to avoid duplication of function, or to reduce extensive duplication.

Educational resources can be exchanged on video-tape -- assuming that all institutions of higher education obtain the same kind of video-tape recorder. No equipment expansion beyond the Expanded Campus Level is needed, although future steps toward a State-wide system would enable various schools to feed directly to one another over a micro-wave system.

3. Feasibility-----A few examplesof special resources which could be shared with other schools include:

CSC------------------Educational Planning Service
Textiles Work
Laboratory School
CSU------------------Hydrology Lab
Agricultural Research
Home Economics and Management
SCSC-----------------Technology
CU-------------------Cyclotron
High Altitude Observatory
State Museum

For further indication of the interest expressed by Colorado schools, see Appendix D -- *Possibilities for the Exchange of Courses and Resources via Television*.

Where a specialized course exists on one campus, and small groups on several campuses are interested in it, the course could be video-taped and sent to other campuses. Combining these enrollments under one professor would make the course economically feasible.

On a nation-wide basis, there are now 324 courses on tape or film available for broadcast and closed-circuit use in education. Breakdown by grade level is as follows:

Elementary	157
Secondary	62
College	52
Adult Education	43
In-Service Education	10
TOTAL	324[2]

A sub-committee of the Mid-America State University Association is considering a proposal for a feasibility study on inter-state exchange of resources via television.

4. Comparative Costs-----------Cost of recording, mailing, and playing a video-tape would vary. However, it would be possible to produce a half-hour video-tape from the State Museum on the CU campus, mail it to another school, and have it played there for $50. It would be unfair to compare this cost to the cost of building a State Museum on another campus. The alternative is to bring the students from the other campus to the State Museum, which would cost at least $50 for one trip. The video-tape can be preserved and shown to many subsequent classes at little cost, and eventual micro-wave linkage would eleminate even the cost of the tape.

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[2] *Instructional Television Materials*, Instructional Television Library Project, 1964.

Similarly, on an inter-state or intra-state basis, the comparison essentially is between having a given resource via television, or not having it at all.

Since most major institutions have some specialized resources, by sharing these resources via video-tape, they could build up credit in a centralized "education bank" which could be used for acquiring, via video-tape, resources which they do not have.

5. Efficiencies Realized--------a. Resources not normally available can be made available at reasonable cost.

   b. The cost avoidance stemming from not having complete resources of human knowledge on every campus is considerable.

   c. The specialized personnel, facilities, and resources of one institution can be used more efficiently by serving the educational needs of more people, and can help one state build up credit for obtaining resources from other states.

D. Extension of Educational Resources Beyond the Campus

1. Need------------a. There is need for an increased program of remedial teaching for school children, and for a program of special education for brilliant school children.

   b. There are 800,000 school drop-outs in the United States today.

   c. "About one-third of the (Colorado) schools made no provision for able and ambitious students". This includes "a total of 10,851 students."[3]

   d. Four million Americans are now enrolled in vocational classes, and this number increases at about 80,000 per year.[4]

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[3] Challenging Able and Ambitious Students in Colorado High Schools, Stephen Romine, Dean, School of Education, University of Colorado.

[4] A. R. Chamberlain, Vice President, Colorado State University, Dividends and Responsibilities of Education Beyond High School.

e. Of 123 million Americans beyond high school age, 95 million are doing nothing to further their education.[4]

f. It is estimated that one-half the knowledge acquired for the B.S. or M.D. degree is obsolete in 7 to 10 years.

2. Television Application (broadcast level)----------By activating Channel 12 in Boulder, at a cost to the State of $151,000 (matched by $206,000 of Federal funds under PL 87-447), and Channel 8 in Pueblo, at a cost to the State of $200,000, plus $200,000 Federal funds -- 88% of the State's population could be covered by educational television.

The programs from these broadcast stations could be received by every home and every school in the area of coverage on normal television receivers.

CU courses on radio, such as Primitive Music, and History of Flight; and, on television, such as Communicate! and Persuasion, indicate that there is an audience for such programming.

3. Feasibility-----All State institutions have a responsibility for general education in Colorado. CSC's programs in education; CSU's Cooperative Extension Service and Experiment Station; SCSC's technical courses, and CU's Extension Division are examples of current efforts in general education which could be expanded through the use of television.

The State program on Municipal Government currently being carried on by the Governor's Committee is an example of a current educational emphasis which could be increased by broadcast ETV.

Community groups in Boulder, Colorado Springs, Pueblo, have expressed keen interest in community broadcasting. Martin Corporation, Mountain States Telephone and Telegraph Company, the Pueblo Army Depot., have expressed interest in specialized courses for industry.

Medical, dental, pharmaceutical programs on new developments for doctors, dentists and pharmacists could originate from CU -- agriculture and economics programs from CSU; technical-vocational programs for industry from SCSC; in-service training programs for teachers from CSC.

ETV stations can serve as enrichment centers for public education by bringing the resources of the universities into the schools. Remedial courses for high school students could be taught via TV, rather than on the college campus. High school students could take certain basic lower division university courses via television, thus qualifying for advanced standing, and reducing the necessity for redundant courses in the colleges.

These stations would be jointly programmed (Channel 12's transmitter would be located so that there could be a direct connection between the transmitter and studios at CU, CSU and CSC) by the institutions of higher learning, and the public schools covered by the station. Funding for basic operation of the station would be to the licensee (University of Colorado for Channel 12; Southern Colorado State College for Channel 8), with programming funds budgeted to the institutions on the basis of the amount and type of programming they were undertaking.

Through the use of broadcast television, a true "University of the People" can be established to meet the myriad educational needs of an increasingly complex society.

4. Comparative Costs----------An educational television station, operating on an annual budget of $330,000 -- programming only 20 hours per week, 52 weeks per year, to an average audience of only 1,000 persons -- is providing education at a cost of 31¢ per student-hour -- a reasonable price for education in an age of which Alfred North Whitehead said:

> "Tomorrow, science will move forward yet one more step, and there will be no appeal from the judgement which will then be pronounced on the uneducated."

5. Efficiencies Realized--------a. Establishment of a low unit-cost type of adult education, continuation education, vocational education, special education, remedial education, and education for exceptional children.

    b. Closer coordination and greater efficiency in extension efforts of the schools.

    c. Avoidance of the cost of an uneducated population.

E. Equalization of Education Through a State-Wide System

1. Need------------In Colorado, as in many states, those areas which most need the advantages of educational television are those which do not have them.

    There is a need, recognized in the Small Schools Project, currently being carried on by the State Department of Education, to provide improved educational resources for many small schools in Colorado, mostly located in the outlying areas.

    The development of junior colleges throughout the State, as recommended by Governor John Love, in his Education Message and his Budget Message of 1964, will require marshalling of all available educational resources, particularly in the early developmental stages of these schools.

2. Television Application (State network level)---------Through the use of micro-wave relays, Channel 12 in Boulder, Channel 6 in Denver, and Channel 8 in Pueblo could be linked. By strategic location of transmitter sites for Channels 12 and 8, it may be possible to do "off-the-air" pickups without the cost of micro-wave. Through translators and

micro-wave links, educational broadcasts could be brought to every community in the State.

Such a State-wide system could be established for $525,786, if existing State Highway Department micro-wave towers and developed sites were used. An Interim Report Concerning Communications Usage in Colorado State Government, by the Management Analysis Office of the Division of Accounts and Control, issued in November, 1963, states on page 13:

"Colorado is in an extremely favorable position regarding an educational television network because the existing State Patrol network already covers the areas which will have to be served by an educational television network. Moreover, the State has on its payroll individuals who are highly qualified to supervise and maintain the system, by virtue of their years of experience with the Patrol micro-wave system and with educational television at the University of Colorado. The only obstacle to the possibility of the State's saving this large amount in capital outlay seems to be the minor problem of modification of the present statutory authorities pertaining to the use of micro-wave.

While speaking favorably of the educational values of a State-wide system of ETV in Colorado and in other states, the interim Report mentions: "The same network, once established, could be used to assist in the rehabilitative efforts of the institutions." (p. 12)

To implement the Colorado Educational Television Network, the following steps would be taken:

a. Development of the micro-wave relay. In the initial stages, this would be a two-way link between Channels 6, 8 and 12; with a one-way link to repeaters or translators where needed on the Western Slope and in outlying corners of the State. Later, these systems could be converted to two-way systems, so that these areas could feed the network.

b. A centralized Programming Office would be established at one of the stations for coordinating the programming which would go to various parts of the State. (The system would be set up so that different programs could be fed simultaneously to various parts of the State.)

c. A Cooperative Programming Board, with representatives from cooperating schools and colleges in the State, would meet regularly to plan over-all programming exchange. (NOTE -- Individual colleges and universities would still be meeting their local needs through closed-circuit and/or broadcast television, with certain programs being exchanged at appropriate hours.)

The use of video-tape recorders at local schools would provide flexibility in recording programs and playing or re-playing them at appropriate times for the local school.

3. Feasibility-----Through the use of a State-wide network, public school courses originating in metropolitan areas could be brought into outlying schools, as part of the Small Schools Project.

As an example, interest has been expressed by the Boulder Valley School District #2 in reaching Nederland High School with additional resources.

Colleges and universities in the State would help enrich the offerings and resources of junior colleges, particularly in their initial stages, by sending courses and resources to them via television.

Existing institutions of higher education on the West Slope could obtain enrichment materials via television from some of the State's larger schools, and could contribute unique material to those schools.

Programs for general adult audiences would also be fed over the system for broadcast, especially series of a timely nature (such as Great Decisions).

4. Comparative Costs-----------Since this system of equalized education throughout the State currently is not being done, there is no cost against which to compare the cost of television.

A comparison can be made, however, between the cost of establishing a State-wide micro-wave system in its entirety, and the cost of establishing such a system using State Highway Patrol towers. The following table shows this comparison:

Two-way closed-circuit micro-wave facilities on Eastern Slope, with distribution facilities to Durango, via Canon City, Buena Vista, and Gunnison:

Using New Sites-------------------	$ 785,786
Using State Highway Sites----------	$ 525,786
SAVINGS----------	$ 260,000

For further details on a proposed State micro-wave system, see Appendix E, Colorado State Educational Television Network, by William C. Lewis.

5. Efficiencies Realized--------Enrichment of the educational facilities of every public school, junior college, and State institution of higher learning in the State of Colorado could be effected in the most economical way, because of the unit cost of television, which is inversely proportional to the number of units served.

F. Additional Values of Educational Television

In addition to the major efficiencies and effectiveness which can be realized through the use of educational television, the following valuable uses of ETV should be noted:

1. Instruction in Specific Courses:

Television facilities provide essential laboratory equipment for teaching courses in broadcasting, journalism, electronics, and other technical courses, and the educational use of television. Such courses are now being taught on each of the campuses under consideration.

2. Classroom Magnification:

Within a given classroom, a television camera and monitors can combine the teaching advantage of chalk-board, overhead projector, opaque projector, and demonstration table. Anything done beneath the camera can be seen by every student within the room (regardless of size) and/or in adjacent rooms equipped with monitors.

3. Research:

Television facilities are needed to explore new developments in the use of TV in education, and in developing new techniques for the radio-television industry. Also, in both technical and sociological areas, observation through television can be an important research tool.

4. Self-Evaluation:

Students can come to the TV studio, or, with portable cameras and tape recorder, TV can come to the classroom, so that students in skills courses can be recorded and can view themselves for self-evaluation and/or evaluation by the professor and class.

5. Education Observation:

Through the use of remote-control observation cameras, students in college education classes can view teaching situations in public schools, rather than going into the classroom, thereby creating an atypical teaching situation.

6. Central Film Distribution:

Through a closed-circuit television system, films can be disseminated to classrooms when they are wanted, at a savings in student projectionists and wear and tear on the films. In this way, timely films which are in demand at many places can be shown to many classrooms simultaneously.

7. Educational Public Relations:

Programs about higher education, coming into most homes in the State through an ETV station, can give the public a better understanding of the aims, objectives and problems of higher education in Colorado.

DEVELOPMENT PLAN SUMMARY:

	CSC:	CSU:	SCSC:	CU:
1964-65	Campus Level Inter-Campus Exchange Level	Developmental	Campus Level Inter-Campus Exchange Level	Campus Level Inter-Campus Exchange Level
1965-66	Expanded Campus Level Inter-Campus Exchange Level	Campus Level Inter-Campus Exchange Level	Expanded Campus Level Inter-Campus Exchange Level	Broadcast Level Channel 12
1966-67	Broadcast Level Channel 12	Broadcast Level Channel 12	Expanded Campus Level Inter-Campus Exchange Level	Broadcast Level Channel 12
1967-68	Continued Broadcast Level	Continued Broadcast Level	Broadcast Level Channel 8	Continued Broadcast Level

Development of West Slope Schools for Exchange of Programs.

1968-69 Linkage of Channel 8 with Channels 6 and 12, and West Slope Schools Exchange.

1969-70 State-Wide Level Throughout Colorado.

CSC: Campus Level Inter-Campus Exchange Level	CSU: Develop-mental	SCSC: Campus Level Inter-Campus Exchange Level	CU: Campus Level Inter-Campus Exchange Level
PROGRAM: 1. Increase observation TV. 2. Produce two telecourses on CCTV. 3. Program exchange experiment. (Studio use: 27 hrs/wk)	1. Do CCTV telecourse (PY 10). (Studio use: 15 hrs/wk)	1. Technical training. 2. Faculty orientation. 3. Program development. 4. Program exchange experiment. (Studio use: 15 hrs/wk)	1. Increase campus telecourses from two to four. 2. Increase DEX courses from two to four. 3. Expand use of VTR 4. Increased research in ETV. 5. Program exchange experiment. (Studio use: 25 hrs/wk)
NEW FACILITIES: 1. Portable VTR. 2. Expanded campus distribution system.	1. Remodel studio. 2. Studio equipment. 3. Install distribution system.	1. Portable VTR.	1. Portable VTR.

DEVELOPMENTAL PLAN FOR ETV (continued)

YEAR: 1964-1965

CSC: Expanded Campus Level Inter-Campus Exchange Level	CSU: Campus Level Inter-Campus Exchange Level	SCSC: Expanded Campus Level Inter-Campus Exchange Level	CU: Broadcast Level Channel 12
PROGRAM:			
1. Offer three telecourses. 2. Expanded program exchange.	1. Expanded extension service programming. 2. Special programs developed. 3. Program exchange.	1. Plan Ch. 8 location and buildings. 2. Expand programming. 3. Expanded program exchange.	1. Dormitory programming. 2. Community programming. 3. Public school programming. 4. Direct DEX programming.
(Studio use: 35 hrs/wk)	(Studio use: 30 hrs/wk)	(Studio use: 25 hrs/wk)	(Studio use: 40 hrs/wk)
NEW FACILITIES:			
1. Second distribution channel.	1. Expanded distribution system. 2. VTR.	1. Establish CCTV to new campus.	1. Activate full-power Ch. 12. transmitter tower antenna STL
		West Slope Schools: Planning.	

DEVELOPMENTAL PLAN FOR ETV (continued)

YEAR: 1965-1966

CSC: Broadcast Level Channel 12	CSU: Broadcast Level Channel 12	SCSC: Expanded Campus Level Inter-Campus Exchange Level	CU: Broadcast Level Channel 12
PROGRAM: 1. Expanded campus programming. 2. Community programming. (Studio use: 40 hrs/wk)	1. Expanded campus programming. 2. Community programming. (Studio use: 40 hrs/wk)	1. Expanded programming. 2. Planning for Ch. 8. (Studio use: 30 hrs/wk)	1. Start classroom observation. 2. Expand program exchange. (Studio use: 50 hrs/wk)
NEW FACILITIES: 1. Expanded distribution. 2. Studio-transmitter link to Ch. 12.	1. Expanded distribution. 2. STL - Channel 12	1. Expanded distribution system.	1. Classroom observation equipment.
	West Slope Schools: 1. Acquire portable VTRs and limited distribution systems for playing video-tapes. 2. Plan studios.		

DEVELOPMENTAL PLAN FOR ETV (continued)

YEAR: 1966-1967

CSC: Broadcast Level Channel 12	CSU: Broadcast Level Channel 12	SCSC: Broadcast Level Channel 8	CU: Broadcast Level Channel 12
PROGRAM: 1. Expanded programming. (Studio use: 50 hrs/wk)	1. Expanded programming. (Studio use: 50 hrs/wk)	1. Community programming. (Studio use: 50 hrs/wk)	1. Film programs for distribution. (Studio use: 60 hrs/wk)
NEW FACILITIES: 1. Additional studio equipment.	1. Additional studio equipment.	1. Activate Ch. 8 transmitter antenna STL	1. Additional studio equipment. 2. Kinescope recorder.
	West Slope Schools: 1. Develop closed-circuit television studios. 2. Exchange tapes.		

DEVELOPMENTAL PLAN FOR ETV (continued)

YEAR: 1967-1968

CSC: Broadcast Level	CSU: Broadcast Level	SCSC: Broadcast Level	CU: Broadcast Level
PROGRAM: 1. Continue existing services.	1. Continue existing services.	1. Link Ch. 8 to Chs. 6 and 12.	1. Link Ch. 12 to Ch. 8.
NEW FACILITIES: 1. Permanent studios.	-----------------	1. Denver microwave link.	1. Permanent studios.
		West Slope Schools: 1. Expanded tape exchange.	

DEVELOPMENTAL PLAN FOR ETV (continued)

YEAR: 1968-1969

West Slope Schools	CSC:	CSU:	SCSC:	CU:
PROGRAM: S-T-A-T-E - W-I-D-E E-T-V N-E-T-W-O-R-K E-S-T-A-B-L-I-S-H-E-D				
NEW FACILITIES: E-S-T-A-B-L-I-S-H S-T-A-T-E M-I-C-R-O - W-A-V-E S-Y-S-T-E-M				

DEVELOPMENTAL PLAN FOR ETV (continued)

YEAR: 1969-1970

CONCLUSION

If Colorado is to make educational use of the television medium to realize greater efficiency and effectiveness in higher education, it is necessary that steps be taken now. This Report is written in the sincere hope that it will provide, not a fixed mold into which to force all future ETV development in the State, but a guide to encourage and coordinate the planning, financing and implementation of educational television in Colorado.

FACTORS BEARING ON EFFECTIVENESS AND EFFICIENCY IN USE OF INSTRUCTIONAL TELEVISION IN HIGHER EDUCATION

By: Richard H. Bell
Head, Radio-TV Section
University of Colorado

I. EFFECTIVENESS

The following conclusions, based on the research in the field, may safely be drawn regarding effectiveness of instructional television:

A. Teaching can be done via television with effectiveness equal to the classroom. Essentially, this statement applies to that aspect of education which is concerned with the transmission of information.

As a result of over 300 controlled experiments, "the conclusions of testers, school administrators, teachers and students alike has been that the average student is likely to learn about as much from a television class as from ordinary classroom methods."[1]

B. In some cases, teaching by television is more effective because of:

1. Better visibility because of magnification.
2. Constant eye contact by the professor with all students.
3. A central focus of attention for all the teaching material.
4. Better use of visual teaching materials.
5. A sense of authority imparted by the television set.

C. Teaching by television is especially effective in teaching involving lecture-demonstrations, such as mathematics or the sciences.

"Mathematics and science, for example, have been outstandingly successful, and so have social studies. History, humanities and literature have been less successful. Language skills and health and safety have been in the middle..."[1]

D. Talk-back facilities combined with closed-circuit television can enable students to ask questions, but television is not an effective medium for discussion. Where give-and-take between student-and-teacher, and between student-and-student is desired, the person-to-person situation is more effective.

E. Television is an effective means of teaching students at home.

"When the home TV students are compared with students taught by television in the classroom, they have almost always done better."[1]

This superiority of the home group is due, in part, to superior motivation, but, the fact remains that the most effective kind of formal teaching in the home comes via television.

F. To date, television teaching has been more effective at elementary school level, less so at the secondary level, and less so at the university level. This is due, in part, to structure of education at these levels, and in part to student attitudes.

"It is clear that televised instruction has been used with greater success in the grades than in high school or college."[1]

G. Student attitudes toward television vary, and unfavorable student attitudes militate against effectiveness of television learning. However, even students unfavorably disposed toward television (as they may be toward other teaching techniques) do learn from television.

"Student attitudes are 'more favorable to subjects where demonstrations are important (for example, natural science and art), less favorable toward subjects where student-teacher interaction and classroom discussion and drill are important (English composition and social studies)'."[1]

"In general, elementary school children are enthusiastic over television classes, high school students are much less so, and college students are equivocal or even, in some cases, unfavorable."[1]

H. Teacher attitude toward instructional television is most favorable at the elementary level, and least favorable at the college level. Experience with television tends to generate a favorable teaching attitude.

"Most teachers who teach on television come to like it."[1]

"The real center of teacher resistance to instructional television is in the colleges."[1]

"Even in the Oregon system, where 'considerable resistance' was found, faculty attitudes were more favorable than unfavorable."[1]

I. Findings on the kind of student who profits most from instructional television are mixed. Both the good student and the poor student can benefit from instructional television, but the comparative degree of benefit is uncertain.

"It may well be, as some recent and unpublished research suggests, that both the brightest and the slowest students may derive some differential benefit from televised teaching -- the former, because they learn rapidly anyway, and television can theoretically offer them a great number and variety of responses to learn; the latter, because television concentrates their attention as the classroom often does not."[1]

J. Class size makes little or no difference in learning from instructional television.

"Students generally prefer to be in small rather than in large classes, but no differential effect of class size on learning from ITV has been reported in cases where viewing conditions were equally satisfactory."[1]

K. Insofar as intangibles can be measured, there seems to be no loss by teaching via television. The feeling that "something magical" happens when the teacher is before the students in the flesh is not justified by the research.

"The research has so far been unable to locate any other intangible losses resulting from instruction by television. There has been some attempt to find out whether televised teaching -- because it presents an 'authority' rather than inviting democratic discussion--might develop authoritarian personalities in students. Carpenter and Greenhill found no evidence to confirm this. The same researchers, however, found that a group of students taught by the discussion group method scored higher on a test of problem-solving than did a comparable group taught by television. In general, however, television students have held their own in tests of critical thinking, problem-solving and other non-rote aspects of learning."[1]

L. Since the professor is not immediately available to students when teaching via television, more responsibility for his education is placed on the student.

"The proper use of television provides new incentives for students to assume more responsibility for learning."[2]

M. Television provides an opportunity for an instructor to improve the quality of his instruction, both because he feels impelled to when he adapts his teaching to this new medium, and because university administrators usually will (and, can afford to) grant him more time for preparation than they can or will for preparation of his conventional teaching.

N. Television as a teaching medium is most effective when it is considered as an integral part of the educational process.

"(Television) permits many variations on the teaching-and-learning process, but its effective use is based upon the same fundamental psychological principles which apply to all successful processes of learning. The attitude of the learner and the results of teaching are as certain to be affected by the quality of instruction and its adaptation to the needs and motivations of the learner in televised as in conventional instruction."[2]

O. Television provides a means of bringing into the classroom outside events and resources in the most effective and immediate manner.

P. Compared to other teaching devices, television is more immediate than films, more effective than radio. In those teaching situations where maximum educational effectiveness and immediacy in reaching many people is important, television can be used effectively.

II. EFFICIENCY

The following information is applicable to efficiency of instructional television. The term "efficiency" is used advisedly, since there is no evidence that television will reduce the over-call cost of education for any educational institution.

A. The types of educational television equipment vary in cost from $2,000 for a classroom enlarger to $333,000 for a full-power broadcast ETV station. Efficiency in the use of television depends on selecting the correct equipment for the job to be done.

B. As an educational dissemination device, television is essentially a mass medium, and its economical use is in direct proportion to the size of the audience.

Station KAET, Arizona State University, is providing educational experiences at a cost of 5¢ per exposure-hour when broadcasting (as it often does) to audiences of over 3,000.

Penn State determined that the student-credit-hour cost of teaching via their closed-circuit system was lower than conventional costs when class sizes were over 200:

(Conventional---$ 9.48;
Television-----$ 5.44)[3]

The University of Colorado Unit Cost Study shows that the break-even point at that school comes with classes of 334 students.[4]

Dr. Donald W. Paden, Professor of Economics at the University of Illinois, states: "...substantial savings are possible when instructional television is used in place of conventional small classroom instruction whenever the number of students exceeds two or three hundred. Savings increase rapidly as the number of students increases beyond this number."[5]

C. A video-tape recorder is an important factor in realizing economies in television teaching. When lectures can be repeated during the semester and in subsequent semesters, savings can be increased.

As Paden states: "...instructional television compares favorably with conventional large lectures on a cost basis when the number of students becomes so large that the usual conventional lecture needs to be repeated."[5]

D. Efficiency in the use of television in education depends to some extent on frequency of use. The cost of a television facility is not excessively high, if it is prorated over many hours of use, with a large number of students viewing. A television facility which is used only rarely is an expensive teaching tool.

E. The experience of the University of California and others indicates that the type of class in which television can be used most efficiently is that in which there are:

1. Over 400 students enrolled in the course.
2. Over two sections of the course.
3. Over 50 students per section.

(This is on the assumption that academically, the course lends itself to effective teaching via television.)

F. In situations where student enrollment in classes increases without a corresponding increase in faculty, television can be used to enable a professor to teach more students without loss of effectiveness, thus achieving increased teaching without a proportional increase in cost.

G. Television can be used to reach and teach students in housing areas and in their homes, thus reducing the strain on existing classroom facilities, and making more efficient use of non-academic areas.

H. Where educational resources exist in one place, and the possible student-users of these resources (either personnel or equipment) are located in dispersed points (be it five miles away, or with a 50-mile radius), these resources can be extended to the students effectively and efficiently through television.

I. Television facilities provide an effective and efficient method of exchanging resources and equipment among various schools.

J. By enabling one professor to teach large, multi-section lecture courses, television can provide time for other professors (who would otherwise be teaching sections of the course) to devote to other teaching, individual or small group conference, or research.

K. The use of television is most effective when it is considered as an integral part of the educational process, with courses designed with television in mind. In the past, television has been added onto an existing system of instruction. For maximum effectiveness, schools and departments should re-consider their entire curriculum, identifying those ways in which television can be used effectively and efficiently, and incorporating it into their total program (either as a method of teaching entire courses, a means of teaching portions of courses, or a classroom supplement) where it can perform an educational function uniquely or better than any other method.

For further uses of television in education, attention is called to A Study of Cost Per Student-Credit-Hour of Teaching via Television at the University of Colorado, by Richard H. Bell, July 23, 1963, pages 6-10.

This brief report is written not as a definite statement of efficiency and effectiveness in ETV, but as a guide to development of such statements on each individual college or university campus in Colorado.

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1. "What We Know About Learning From Instructional Television". Wilbur Schramm, in Educational Television -- The Next Ten Years. The Institute for Communication Research, Stanford University, 1962.

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3. An Investigation of Closed-Circuit Television for Teaching University Courses. Report Number Two. Pennsylvania State University. Spring, 1958.

4. A Study of Cost Per Student Credit Hour of Teaching via Television at the University of Colorado. Unpublished. Richard H. Bell. July 23, 1963.

5. "The Teaching of Economics at the College Level". Donald W. Paden, in Televised College Courses. John W. Meaney Fund for the Advancement of Education. October, 1962.

SUMMARY:

STATUS OF FEDERAL FUNDING FOR ETV
January 1, 1964

I. INITIAL LEGISLATION

A. The Educational Television Facilities Act, PL 87-447, became law on May 1, 1962. This Act authorized the Federal government to make available, over a five-year period, a maximum of $32,000,000 to "assist (through matching grants) in the construction of educational television broadcasting facilities."

B. Some of the limitations on the granting of such funds are:

1. No more than $1,000,000 can be allocated within one State.
2. Funds must be used for broadcast facilities, and cannot be used for closed-circuit educational television.
3. Applicant must be: (a) an officer responsible for public instruction within the State; (b) a State ETV agency; (c) a tax-supported college or university, or (d) a recognized non-profit ETV organization.
4. Matching funds must be available to the applying institution.

C. Major determination of approval and size of such grants will be based on criteria designed to achieve.

1. Prompt and effective use of all educational television channels remaining available. (For this reason, grants to be used for activation of new ETV stations take priority over requests for grants to improve an existing ETV service.)
2. Equitable geographical distribution of educational television broadcasting facilities throughout the states.

3. Provision of educational television broadcasting facilities which will serve the greatest number of persons, in as many areas as possible.

II. IMPLEMENTATION OF THIS ACT

A. In May, 1963, the late President Kennedy signed the 1963 Supplemental Appropriation Bill, which contained provision for $1.5 million to ETV construction. Part of this amount will go to establishing the machinery for awarding these grants. The remainder will be granted on a "first-come, first-served" basis to some of the institutions who already have applied.

B. The Department of Health, Education and Welfare, which decides on all grants under this Act, has mailed rules and regulations regarding disbursement of these funds to all interested parties.

C. HEW has requested Congress to make available $7,000,000 for disbursement during the 1963-1964 fiscal year. The Senate approved this amount; the House cut it to $5,000,000, and the issue has gone to Committee.

By the end of 1963, HEW had accepted a total of 48 applications for Federal aid to ETV: 24 for new stations for a total of $9,287,384, and 24 to expand existing ETV facilities for a total of $5,154,344. Requests for the remaining $17,558,272 can be expected to be submitted to the HEW within the year 1964.

III. IMPLICATIONS FOR HIGHER EDUCATION IN COLORADO

A. HEW has made a tentative breakdown as to the funds needed by each state. Colorado's share of Federal funds, if matched locally, is $663,393. Of this amount, Station KRMA was granted $58,688 on December 9, 1963.

B. HEW has indicated that this amount will not be held indefinitely for a state which does not use it. In this event, states with greater demands (not to exceed $1 million) will be given more -- those States in which there is less activity may receive less than the originally estimated amount.

C. Since Congress will soon be appropriating funds to be allocated for the fiscal year, and no matching State funds are available for 1964-1965 in Colorado, it is apparent that the earliest likely date at which State institutions could qualify for such a grant would be the beginning of the 1965-1966 fiscal year. However, requests may be submitted prior to time of matching funds becoming available, in order to obtain a lower file number.

D. It is believed that Colorado's full share of Federal funds will continue to be available through the 1965-1966 year. After that, any funds not requested by this State are liable to be allocated to other states.

E. At present, it would appear the logical qualified candidates for Federal grants under PL 87-447 (in addition to KRMA) are: the University of Colorado, applying for Channel 12, Boulder; and Southern Colorado State College, applying for Channel 8, Pueblo.

APPENDIX C

A STUDY OF COST PER STUDENT-CREDIT-HOUR OF TEACHING VIA TELEVISION AT THE UNIVERSITY OF COLORADO

By: Richard H. Bell
Head, Radio-TV Section
University of Colorado

The attached study is included in this Report to provide a financial guide to the use of television in higher education, although it is still undergoing study, evaluation, and revision at the University of Colorado.

It has been pointed out by J. W. Bartram, Budget Director at the University, that the average student-credit-hour cost for teaching the ten courses listed in Section IV of this Report by existing methods is $5.50, a figure lower than the $8.30 student-credit-hour cost for teaching via television. This fact is being taken into consideration as we re-evaluate the comparative cost structures being used.

Four factors which must be kept in mind regarding this cost analysis:

1. It is based on the use of broadcast television equipment, since the CU studios have been equipped with the facilities for eventual activation of Channel 12, and not just for closed-circuit. For closed-circuit use, less expensive cameras, video-tape recorders, etc. can be used.

2. A video-tape recorder has been added to the University's ETV facility since this Report was compiled, and currently, we are studying the cost-reduction brought about by repeat presentation of video-taped lectures.

3. A comparison of the academic time category, the most expensive category, in the television teaching situation, and the conventional situation is being undertaken to make sure that they are being compared on the same basis.

4. The figures used in this study are based on the assumption that all TV expenses are attributable to teaching via closed-circuit televison, and does not take into consideration the other uses of the same television facility as listed elsewhere in the Association's Report.

It should be understood that these unit cost figures cannot be assumed to be valid for other Colorado institutions of higher education. Differing goals for educational television will dictate the use of different television equipment at different schools.

Further, patterns of faculty utilization and personnel policies on each campus are varied anough to skew the figures which are developed here on the basis of policies pertaining currently at the University of Colorado. Also, in the future, cost factors, both for equipment -- and for personnel, will have changed.

It is believed, however, that these figures give a valid general indication of television teaching costs, and that the form used may be of assistance to other schools in carrying out studies to determine their own student-credit-hour cost figures for teaching via television.

APPENDIX C (continued)

A STUDY OF COST PER STUDENT-CREDIT-HOUR OF TEACHING VIA TELEVISION AT THE UNIVERSITY OF COLORADO

July 23, 1963

I. INTRODUCTION

During June and July, 1963, a study was made of the student-credit-hour cost of teaching via television at the University of Colorado in order to provide data on which to plan future steps in the development of ETV at this institution.

A form for tabulating unit costs of television was developed, and nine different models were worked out, each with different basic assumptions. Model #1 is based on actual expenses of teaching via television during the 1962-1963 school year. Models #2 through #6 are cumulative steps in the development of closed-circuit ETV on the Boulder campus and at Denver Extension Center. Model #2 was used as the base on which the succeeding four models are based. Model #7 involves a second institution of higher learning, connected to the University of Colorado by micro-wave relay, and Model #8 expands the number of courses offered. Model #9 moves into a different expense structure, as it involves broadcast over an ETV station on Channel 12, reserved for education in Boulder.

It is hoped that this form can be used for figuring costs on other ETV structures, both at the University of Colorado, and at other educational institutions.

II. FINDINGS

The following student-credit-hour costs were determined:

Model:	Description:	Cost per SCH:
#1	Actual Cost of Five Courses, with Discussion Groups, and DEX Link Second Spring Semester 1962-1963----------------	$ 28.84
#2	Three Three-Hour Lecture Courses Per Semester on Campus (Base)---------	$ 25.96

Model:	Description:	Cost per SCH:
#3	Three Three-Hour Lecture Courses Per Semester, plus DEX Link and 1" VTR	$ 22.61
	UPPER DIVISION SCH COST at CU, 1961-1962	$ 21.27
#4	Three Three-Hour Lecture Courses Per Semester Plus DEX Link, 1" VTR, and Three More Campus Viewing Rooms	$ 17.21
	ALL LEVEL SCH COST at CU, 1961-1962	$ 17.00
#5	Three Three-Hour Lecture Courses Per Semester, Plus DEX Link and 1" VTR, plus Six More Campus Viewing Rooms	$ 12.14
	LOWER DIVISION SCH COST at CU, 1961-1962	$ 10.91
#6	Three Three-Hour Lecture Courses Per Semester, Plus DEX Link, 1" VTR, and 600 Student Stations (450 on-campus; 150 at DEX)	$ 10.74
#7	Three Three-Hour Lecture Courses Per Semester, DEX Link, 1" VTR, 600 CU Student Stations, and 300 Student Stations on-campus of a Second Institution	$ 9.85

Model:	Description:	Cost per SCH:
#8	Six Three-Hour Lecture Courses Per Semester, DEX Link, 1" VTR, 600 Student Stations, and 300 Student Stations at Second Institution	$ 8.30
#9	Operation of ETV Station on Channel 12, with 2" VTR, Covering 600 Student Stations at CU, 300 Student Stations at each of 2 Other Institutions	$ 9.00

III. INTERPRETATION

A. It should be noted that these figures are slightly skewed in favor of SCH costs by conventional teaching methods, as the conventional SCH figures are for 1961-1962, when average faculty salary was $8,904. All faculty salaries for ETV SCH costs are figured at $10,000, the 1962-1963 average figure, and professional ETV personnel are included at the 1963-1964 salary level.

B. Student Assistant costs for ETV are figured arbitrarily at 1/2 Student Assistant (10 hours per week) for every 100 students, or portion thereof, in a telecourse. Many campus courses taught by conventional methods do not have this favorable a ratio of Student Assistants. (There is no standard campus policy which could be used in this regard, as policy varies from department to department.)

Concerning Graduate Assistants, it is assumed that the instructor would use these students in various ways -- assigning them discussion sections, using them as paper-graders, and in other ways that best suit the structure of the given course.

C. Break-even point where conventional costs and ETV teaching costs are the same, as indicated by this study, comes when the ETV assumptions are met and there is an average of 334 students in each course. This is somewhat higher than the 200 break-point obtained at Pennsylvania State

University, where many different factors pertained (closed-circuit cameras, etc.). It is somewhat closer to figures obtained by Dr. Donald W. Paden, Professor of Economics at the University of Illinois, who stated in The Teaching of Economics Via Television at the College Level: "...substantial savings are possible when instructional television is used in place of conventional small classroom instruction whenever the number of students exceeds two or three hundred."

D. In any comparison of ETV costs on various campuses, and of ETV costs versus conventional instruction on one campus, it should be noted that the cost figures derived stem directly from the basic assumptions. Hence, in this study, the base established in #2 is valid, providing that 80% of the 180 student stations are in use for three three-hour courses per semester, and that these are basically lecture courses, with one Graduate Assistant (i.e. 20 hours per week) per course. The actual costs for 1962-1963 were high, primarily because one course was given live twice a day, with three professors and four Graduate Assistants involved.

E. It should be noted that of all the variables, the one which had the most direct effect on SCH cost was number of students. Increasing the number of student stations from 330 in #4 to 510 in #5 reduced SCH cost by $5.04. Doubling the number of courses offered also reduced the SCH cost, but only by $1.55. Number of students reached seems to be the critical factor in cost accounting for instructional television.

F. Although there is a constantly decreasing SCH cost as the number of students increases, the rate of decrease is slowed as the numbers get larger. The following chart indicates this:

Model #:	Student Stations:	80% Capacity:	Cost per SCH:	Decreases:
#4	330	264	$17.21	----
Step	420	336	$14.13	$ 3.07
#5	510	408	$12.14	$ 1.99
#6	600	480	$10.74	$ 1.40
Step	690	552	$ 9.71	$ 1.03
Step	780	624	$ 8.92	$ .79

The step between #4 and #5, and the two steps beyond #6 were tabulated in order to provide a steady increase of 90 student stations (based on three 30-seat classrooms, which was used as a standard in this study). It was assumed that for every 90 students added, cost was increased by $3,675 ($3,450 for one-half more Student Assistant per course, and by $225, the yearly amortization cost of $750 per room for installation of receiving equipment).

IV. LARGE CLASSES AT CU

Since Model #6 is slightly lower than the lower division SCH cost for standard instruction, and is based on 600 student stations (450 on-campus, and 150 at DEX), it is apparent that from an economic standpoint, instructional television lends itself to large class instruction. How many classes at CU come in this category? Below is a list of lecture courses in Fall, 1961, which met the following criteria:

A. Over 400 students enrolled in the course.
B. Over two sections in the course.
C. Over 50 students per section.

These criteria were adopted from a study done by J. G. Paltridge, Statewide Coordinator of ETV at the University of California, and help determine which courses are large, multi-section courses with little opportunity for real discussion in the sections -- and hence, which would lend themselves (unless other particular characteristics of the course dictate otherwise from a teaching standpoint) to presentation on television.

These courses are:

Anthropology 103
Biology 101
Chemistry 103
Economics 201
Education 205

Geography 100
Geology 101
History 101
Mathematics 101
Psychology 201

If criterion C is changed to all those which number more than 20 students in the sections, the following courses can be added to this list:

Engineering English 101
English Language 100
English Language 101
English Literature 110
French 101
German 101
Political Science 101
Sociology 111

V. ADDITIONAL BENEFITS OF OPERATING A TELEVISION SYSTEM

Although this study has placed the entire justification of an educational television facility on teaching via television, it should be noted that, once these facilities are established and manned, they can be used in the following additional ways at little or no increase in cost:

A. Television Studios

1. Instruction of students enrolled in courses in broadcasting.
2. In-service training of faculty in use of television in higher education.
3. Acquainting education students with methods and techniques of using television for educational purposes.
4. Providing television experience for students working as members of the engineering and production crews.
5. On-camera rehearsal of programs to be done by faculty or students over broadcast stations.
6. Use as classrooms when magnification of demonstrations are desired in any course.

B. Studios Plus VTR

1. Preparation of programs of a general educational or public relations nature for broadcast over local commercial or ETV stations.
2. Preparation of programs.
3. Recording of special guests to the campus for showing to students at a later time.

4. Recording of special demonstrations or presentations which may not be available, in the future, or which would be expensive to reproduce again. (Such tape recordings can be transferred to film for about $185 per half hour -- a very inexpensive way in which to produce a film of this length.)

5. Recordings of student skills which the student can view later for self-evaluation.

6. Playing courses and resources material obtained on tape from other schools.

C. Studios Plus VTR Closed-Circuit Loop

1. Reception of off-campus programs (i.e. inauguration of the President of the United States), feeding it to selected classrooms in which monitors are located.

2. Visual linkage between the Registrar's office and the Field House for dissemination of rapidly changing information during registration (as do the airlines).

3. Link from the Library to other parts of the campus for visual dissemination of library information. Also, from the Registrar's office to various faculty office buildings for the same purpose.

4. Observation of classes in elementary and secondary schools by teacher-education students.

5. Dissemination of large or dangerous equipment (i.e. the cyclotron) to many classrooms simultaneously.

6. Use of TV camera as an enlarger of demonstrations and distribution of this magnified picture to other classrooms.

D. Studios Plus VTR, Plus CCTV, Plus DEX Link

1. Provides a link whereby programs can be originated on-campus and fed directly to broadcast stations.

2. Provides a link whereby courses can be originated on-campus and fed directly to industries which can link to the DEX and receive the courses in their plants.

3. Link the Boulder campus and DEX for administrative purposes.

4. Link the CU Medical School in Denver with the Boulder campus for the exchange of special lectures and demonstrations.

E. Broadcast Station

1. Provide general educational and cultural programs for informal adult education.

2. Provide courses which can be taken for credit at home, in conjunction with Extension and Correspondence Study.

3. Offer resources for local community study groups via television.

4. Reach special interest groups, such as doctors or lawyers, at their homes, with information regarding new developments in their fields.

5. Provide courses in literacy for adults who do not read or write English effectively. (The U. S. Office of Education estimates that there are 10 million functional illiterates in the United States.)

6. Offer resource material to public schools in the area.

7. Provide a channel by which public schools can put master teachers into outlying schools which do not have the qualified teaching staff which is needed.

8. Provide a channel for in-service training for teachers in the schools.

9. Acquaint adults with the aims and objectives of education in order to develop better understanding of our educational institutions.

10. Offer programs for the home-bound child, the bilingual child, the retarded child, the brilliant child.
11. Provide a channel through which to carry on retraining of technologically unemployed adults.
12. Provide courses for high school and college dropouts to enable them to continue their educations.
13. Provide a basic station for a future State-wide ETV system.

VI. QUESTIONS TO BE EXPLORED

Several basic questions need to be explored in order to see how television can best be used. Some of the most important are:

1. Can we re-structure our teaching system to make better use of modern technology?

   We are still super-imposing television (and other new teaching devices) on an existing system, and often are not making most efficient use of them. If courses were re-organized to make some information-transmitting courses, these could be put on television with a resulting savings in professorial time and effort, and no loss in educational effectiveness.

2. What economies can be realized through use of the VTR?

   Paden indicates that, under certain conditions, the use of video-tape greatly reduces the cost of teaching via television. This should be explored more fully at the University of Colorado.

3. Related to this is: can we work out an equitable arrangement in regard to a professor's rights when his course is put on tape?

   Currently, this is a key question facing ETV. The method and amount of reimbursement to a professor who has taped a course has a direct bearing on unit cost of instruction.

4. Is the use of talk-back in our telecourses worth the expense?

   There is evidence that the talk-back was little-used in 1962-1963. Unless the course can be structured to make better use of this facility, it should be discontinued, thus reducing the cost of DEX link by $100 per month.

5. What new techniques can be devised for making teaching via television even more effective and efficient?

   Constant experimentation is needed here.

6. Can we obtain inter-institutional cooperation in the use of telecourses?

   This is a major factor in realizing future economies in ETV. This consideration should be related to Differentiation of Function Report for State Institutions, and to the Report of the ETV Committee of the Association of State-Supported Institutions of Higher Education in Colorado.

7. Can we obtain matching funds in time to take advantage of PL 87-447, which provides funds for establishment of ETV stations?

   Unless we use these Federal funds by 1965-1966, Colorado probably will lose all or much of them.

VII. RECOMMENDATIONS

On the basis of this study, it is recommended that the University of Colorado:

A. Seek to achieve the level of operation outlined in #4 by Spring semester, 1963-1964, since we will have the technical capability of doing so at that time.

B. Request 1964-1965 budget, which will enable us to reach the level of operations shown in #6.

C. Attempt to secure a 1965-1966 budget which will make possible the activation of Channel 12, and the achievement of Model #9. I would not recommend attempting to realize #7 and #8, as I believe that many factors indicate that we could move most effectively directly from #6 to #9.

UNIT COST FOR TEACHING VIA TELEVISION -- UNIVERSITY OF COLORADO

I. BASED ON: ______________________________

ASSUMPTIONS:

No. of Courses ____
  First Time ____
  Second Time ____
  Third Time ____
No. in Preparation ____
Credit Hrs. per Course____

No. of Student Stations____
No. of Disc. Sections ____
VTR? ____
Link to DEX? ____
Link to Other School? ____
Broadcast? ____

II. ANNUAL COSTS: (two semester academic year)

Expense Category: Costs: Total:

A. Academic Time

1. Professorial

(Based on salary of $10,000 per year, full load of 9 hrs. per semester. Released time--2-1 for preparation and first time; 1-1 for subsequent live presentations, and for presentation of taped course.) ________

2. Student Assistants ________

(Based on $2,300 for Student Assistant for academic year, 20 hrs. per week, one-half Student Assistant per course per 100 students in class.)

TOTAL ________

B. Equipment

1. Leased studio equipment
  Initial cost ______
  Amortized over 10-year period ________

Expense Category:	Costs:	Total:
2. Owned studio equipment		
Initial cost________		
Amortized over 10-year period	________	
3. Viewing Room Equipment		
Initial cost________		
Additional rooms at $750/room______		
Amortized over 10-year period	________	
4. Micro-wave Links		
DEX Link on Phone Co. lease	________	
Owned Link Cost______		
Amortized over 20-year period	________	
5. Other	________	
TOTAL		________

C. **Operations**

1. Professional		
a. No. of Producers_____		
At salary of________	________	
b. No. of Engineers_____		
At salary of________	________	
c. No. of Secretaries___		
At salary of________	________	

(Based on one producer, one engineer, and one-half secretary for three courses per semester.)

2. Student Crew		
________ students		
________ hours per week		
________ weeks per year		
________ per hour	________	

(Based on 5 students, 20 hours per week, for three courses per semester.)

Expense Category: Costs: Total:

3. Maintenance
   - a. Studio equipment ________
   - b. VTR equipment ________
   - c. Micro-wave equipment ________
   - d. Tape costs ($1.00 per pass for broadcast VTRs; 21¢ per pass for 1" tape)

Number of recording passes___
Number of play-back passes___
(45-50-minute presentations for three-hour course) ________

e. Transmitter ________

TOTAL ________

D. Operating Costs

1. Cost per course________
(Average cost of $1,000 per course, charged first time presented.)
No. of Courses First Time___ ________

TOTAL ________

GRAND TOTAL OF COSTS ________

III. STUDENT CREDIT HOURS

1. Number of student stations available________
Utilized at 80% of capacity, no. of students per course___
2. Number of credit hours per course ___
3. Number of courses aired per year ___

TOTAL STUDENT-CREDIT-HOURS ___

IV. COST PER STUDENT-CREDIT-HOUR

Total Annual Cost ________
Divided by Total SCH ________

COST PER SCH ________

V. CONCLUSIONS

____

____

____

____

____

____

____

____

_______________________________________.

POSSIBILITIES FOR THE EXCHANGE OF COURSES AND RESOURCES AMONG COLORADO INSTITUTIONS VIA TELEVISION

The following lists represent courses which might possibly be exchanged. The list was derived differently at different schools, and in no case does it represent a committment on the part of any school. Many details would need to be worked out before exchange of specific courses could be accomplished. This listing does give an idea of the scope and range of possible exchange.

I. CSU

A. CSU courses which could be video-taped for use by other State institutions:

Agricultural Engineering:
- AE 269 -- Fluid Mechanics of Porus Media
- AE 152 -- Design of Farm Irrigation Systems
- AE 154 -- Drainage Theory and Design

Anatomy:
- Ay 2 -- Introduction to Human Anatomy
- Ay 4 -- Anatomy of Farm Animals
- Ay 131 -- Kinesiology
- Ay 140 -- Functional Anatomy of Game and Fur Animals
- Ay 170 -- Neurology
- Ay 181 -- Ultrastructural Cytology

Animal Science:
Possibly some for use at Fort Lewis.

Chemistry:
- C1 -- Natural Science

Economics and Sociology:
All course offerings could be taped.

Electrical Engineering:
EE1, EE2, EE20, EE121, EE122, EE123, EE136, EE137, EE138

English:
- E 104 -- Speech Disorders
- E 80, 81, 82 -- Introduction to Humanities
- Pl 100, 101, 102 -- History of Western Philosophy
- Sp 28 -- Speech Personality
- E 119 -- Modern English Grammar
- Jt 1 -- Introduction to Journalism

Foods and Nutrition:
FN 10 -- Survey of Nutrition

Forest Recreation and Wildlife Conservation:
RW 100, 102, FS 3, RW 160

History and Political Science:
PO 1 -- American Government
PO 31 -- Current World Problems
Hy 75, 76, 77 -- American History
Hy 51, 52, 53 -- History of Civilization
Eventually, all the courses.

Music:
Mu 12, 13, 14 -- Understanding Music
Mu 15, 16, 17 -- History of Music
Mu 51, 52, 53 -- Instruction on Instruments of the Orchestra and Band

Occupational Therapy:
O.T. Methods
Technical Homemaking for the Disabled

Pathology and Microbiology:
PB32, PB102, PB110, 112, 114, 125, 127, 141, 147, 172, 223, 227, 230, and labs excluded.

Physics:
Ph 21, 22, 23 -- General Physics

Poultry Science:
Pl 55, 103

Psychology:
Py 10, 60, 81, 82

Range Management:
RM 12

Veterinary Clinics and Surgery:
VS101

Veterinary Medicine:
VM 25 -- Animal Hygiene

Zoology:
Z1, 5, 7, 110, 120

B. Courses produced by other State institutions which might be used by CSU:

Agricultural Engineering:
  Farm machinery
  Farm power
  Agricultural product processing
  Agricultural materials handling

Electrical Engineering:
  Same as listed under A.

English:
  There may be many.

Forest Recreation and Wildlife Conservation:
  Elementary Law
  Physical Biology
  Special Ecology
  Aquatic Botany

Industrial Arts:
  Basic Graphic Arts

Music:
  Same as listed under A.

Physics:
  Quantum Mechanics by outstanding physicists.

Poultry:
  Poultry disease
  Feeding poultry

Psychology:
  Same as listed under A.

Veterinary Clinics and Surgery:
  VS 101

Vocational Education:
  Possibly some.

II. CSC

A. Can offer:

Special education facility observations.

Educational Planning Service -- school construction laboratory.

Theatre productions.

In-service work for teachers of the State.

Textile work.

Laboratory school music instruction.

B. Could use:

Psychological counseling exchange with CSU.

Material from CU observatory.

Theatre productions.

CSU hydrology laboratory material.

CU cyclotron material.

Exchange with CU print department.

Exchange with IA and HE departments at CSU.

Exchange of military personnel and information via television.

Specific courses for exchange to be worked out.

III. SCSC

Geology -- wants tape on Geological Museum.

Agriculture -- programs from CSU.

Biology -- CU biology laboratory equipment and techniques.

Geology -- exchange of geological specimens of different areas.

Debate -- exchange.

Specific courses to be exchanged to be worked out.

IV. CU

A. Could provide:

Resources from the:
Nuclear Physics Laboratory
The High Altitude Observatory
Institute of Arctic and Alpine Research
The School of Medicine
Colorado State Museum
Engineering Experimental Station
School of Pharmacy

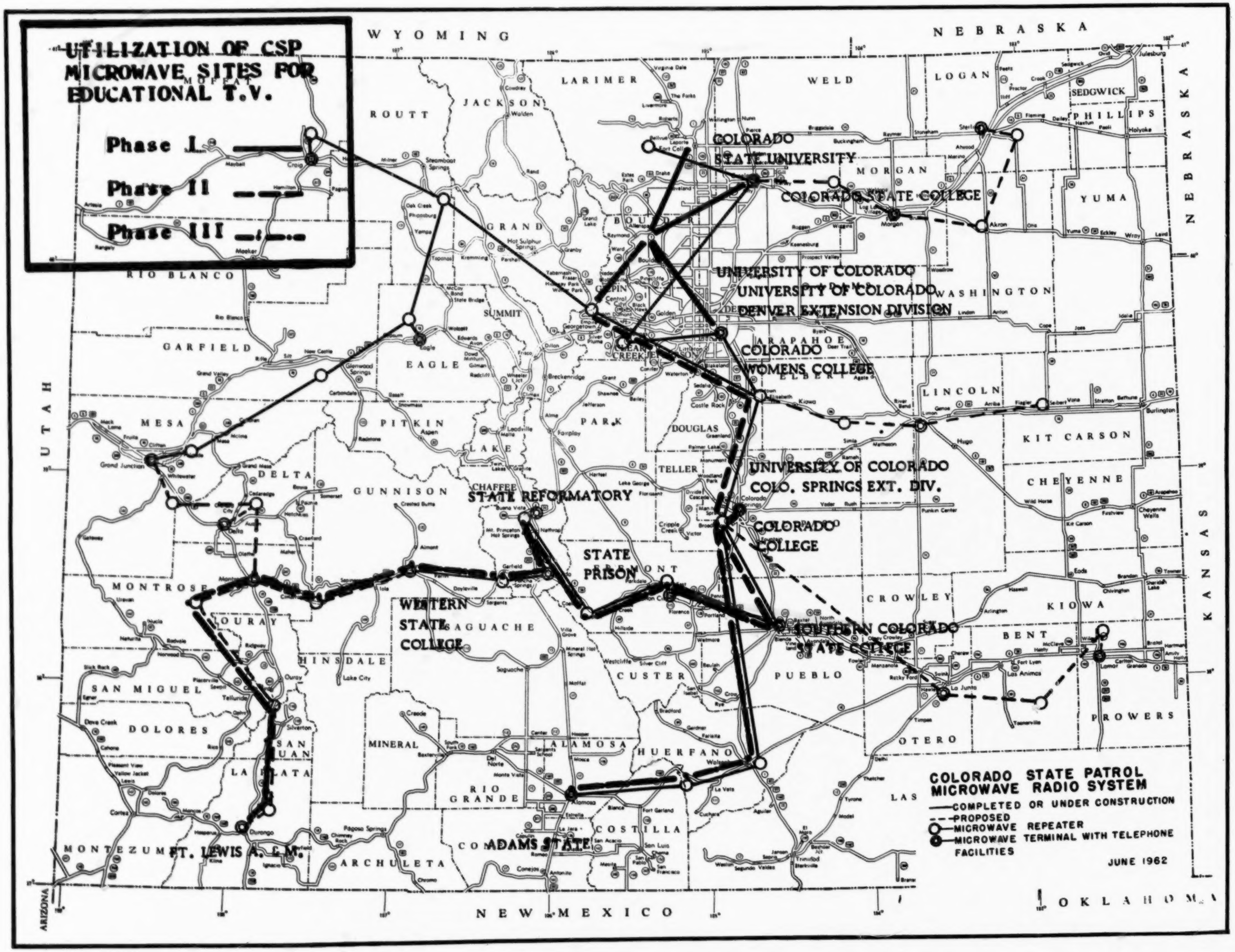
Cultural resources, such as the Hungarian String Quartette.

B. Could use:

Engineering material from School of Mines.
Resources of the Hydrology Laboratory at CSU.
Laboratory School Resources from CSC.
Guest resources for architecture courses.
Material from Educational Planning Center at CSC.

C. Exchange:

Debates.
Theatre productions.
Other creative activities, student and faculty, common to several campuses.
Specific courses to be exchanged to be worked out.



UTILIZATION OF CSP MICROWAVE SITES FOR EDUCATIONAL T.V.

Phase I
Phase II
Phase III
COLORADO STATE UNIVERSITY
COLORADO STATE COLLEGE
UNIVERSITY OF COLORADO
UNIVERSITY OF COLORADO DENVER EXTENSION DIVISION
COLORADO WOMENS COLLEGE
UNIVERSITY OF COLORADO COLO. SPRINGS EXT. DIV.
COLORADO COLLEGE
SOUTHERN COLORADO STATE COLLEGE
STATE REFORMATORY
STATE PRISON
WESTERN STATE COLLEGE
ADAMS STATE
FT. LEWIS A. & M.
COLORADO STATE PATROL MICROWAVE RADIO SYSTEM
COMPLETED OR UNDER CONSTRUCTION
PROPOSED
MICROWAVE REPEATER
MICROWAVE TERMINAL WITH TELEPHONE FACILITIES
JUNE 1962
WYOMING
NEBRASKA
KANSAS
OKLAHOMA
NEW MEXICO
UTAH
ARIZONA
MOFFAT
ROUTT
JACKSON
LARIMER
WELD
LOGAN
SEDGWICK
PHILLIPS
MORGAN
YUMA
RIO BLANCO
GRAND
BOULDER
WASHINGTON
GARFIELD
EAGLE
SUMMIT
GILPIN
CLEAR CREEK
ARAPAHOE
ELBERT
LINCOLN
MESA
PITKIN
LAKE
PARK
DOUGLAS
KIT CARSON
DELTA
GUNNISON
CHAFFEE
TELLER
CHEYENNE
FREMONT
MONTROSE
OURAY
SAGUACHE
CROWLEY
KIOWA
BENT
HINSDALE
CUSTER
PUEBLO
SAN MIGUEL
PROWERS
DOLORES
SAN JUAN
MINERAL
ALAMOSA
HUERFANO
OTERO
LA PLATA
RIO GRANDE
LAS ANIMAS
COSTILLA
CONEJOS
MONTEZUMA
ARCHULETA
Grand Junction
Durango
Alamosa
Walsenburg
Pueblo
La Junta
Lamar
Sterling
Akron
Fort Collins
Boulder
Limon

COLORADO STATE EDUCATIONAL TELEVISION NETWORK

by
William C. Lewis,
Chief Engineer for Television
University of Colorado

INTRODUCTION

As the utilization of television as a teaching tool grows throughout the institutions of higher education in Colorado, it will eventually become desirable to link the facilities of each institution so that effective and immediate exchange of educational material can be accomplished. The most practical way to accomplish this exchange will be via a closed-circuit, micro-wave network. Such a network is an integral part of the plans of the ETV Committee of the Association of State-Supported Institutions of Higher Education in Colorado.

This Report is written to advise interested parties of some of the possibilities of such a network, and of the possibilities of constructing this network in the rugged Colorado mountains at minimum cost. Readers must bear in mind that this Report is based on long-range thinking now being done by educators in Colorado. It is predicated on utilization, where possible, of all existing micro-wave sites now owned by the State, and, the fact must be realized that, with suitable engineering study, some of these sites might be eliminated from the final network and costs lowered.

WHY BUILD AN EDUCATIONAL TELEVISION NETWORK?

The primary reason for the construction of a television network for education in Colorado is to provide additional resources for teaching to all institutions. Examples of resources which might be exchanged are found in Appendix D of Television for Higher Education in Colorado: A Five-Year Plan, March 1, 1964.

Extension teaching provides another use for an ETV network. At the time of writing, the University of Colorado leases a microwave circuit from the Mountain States Telephone and Telegraph Company for the purpose of teaching at the Denver Extension Center courses offered in Boulder. This enables extension students to take advantage of the personnel and teaching resources of the Boulder campus.

This link also provides the basic connection for feeding from the University of Colorado TV studios to Denver TV stations for live broadcast, for linking with the University's Medical School, and for providing courses which can be taken by industrial and business workers via television without leaving their places of employment. Expanded utilization of television in Extension teaching could provide course materials on the Denver Extension and Colorado Springs Extension campuses identical to those on the Boulder campus.

With a micro-wave system which would carry educational materials throughout the State, extension teaching could be brought into many communities now being serviced by Community Antenna TV Systems. With agreement from system operators, direct connection could be made with these systems, providing an educational resource to residents of communities which are out of reach of present and proposed ETV stations.

Utilization of "open-circuit" educational television through activation of the various allocated educational channels in the State would provide the population centers with the maximum educational resources only if the program material could be fed from various institutions throughout the State to the operating transmitters. Further, the Western Slope State colleges (Adams State, Fort Lewis A & M, Western State) are far beyond the range of any of the three VHF educational channels, and can receive and contribute to the programming of these stations only through a micro-wave system.

HOW WOULD SUCH A MICRO-WAVE SYSTEM BE CONSTRUCTED?

Construction of a complete State-wide Educational Television Micro-wave facility would be a large undertaking, and would need to be developed as part of the State-wide planning of the Association's ETV Committee. The following steps in the development of a micro-wave system would be consistent with the present planning of this Committee.

Phase I:

Phase I of the construction of a State micro-wave system would involve the improvement of a micro-wave site near Boulder which could provide line-of-sight service for either broadcast or micro-wave transmission to Fort Collins, Greeley, Boulder and Denver. Such a site could also provide line-of-sight transmission to a site located on the existing State Patrol micro-wave system.

An immediate function of Phase I of this plan would be the elimination of the currently leased micro-wave facilities between the Denver Extension and the University of Colorado in Boulder. Also, part of Phase I would be the installation of micro-wave inter-connection facilities between institutions in the area mentioned above, when the institutions are ready for the exchange of material.

It would be well to note that development of such a facility in the type of location described would be a great advantage when a broadcast station is put on the air on Channel 12. Such a station could provide one-way transmission to all institutions in its coverage area, and the micro-wave equipment could be used to provide facilities to feed the Channel 12 transmitter from any of the aforementioned cities.

Phase II:

Phase II of the micro-wave system will provide extension of the network to institutions in Colorado Springs and Pueblo. This would include Colorado College, the Colorado Springs Extension of the University of Colorado, and Southern Colorado State College. It is proposed that such a system extension utilize existing sites and towers now used by the State Patrol micro-wave network. Such utilization would have to be done with the approval of the State Patrol, and only after a complete engineering study determined that the existing sites were capable of taking the extra equipment without disturbing the existing service. Such utilization will cut the cost of the installation of a State-wide ETV micro-wave network by a great percentage.

To provide full facilities in both Phase I and Phase II, a two-way system should be provided. Thus, any institutions can originate as well as receive program material. It should be stressed that these facilities can be installed in stages, providing only one-way service at the outset, and two-way service when needed.

Phase III:

Phase III would provide one-way network service to the State Prison at Canon City, to the institution at Buena Vista, and to the State Colleges at Gunnison, Durango and Alamosa. Installation of this system should make use of existing developed State Patrol micro-wave sites. Such an extension would provide additional course material for the above areas.

Phase IV:

To go farther than Phase III is, at this time, more speculation than planning. A part of Phase IV could be the connection to Western Slope CATV systems for extension teaching, and inclusion of junior colleges throughout the State. Also, material could be provided for television stations on the Western Slope for general broadcast. Included in Phase IV could be facilities so that Western Slope institutions of higher education could originate program material for use by Eastern Slope institutions.

WHY MAKE USE OF STATE PATROL MICRO-WAVE FACILITIES?

A considerable saving to the people of the State can be realized by using the improved sites of the State Highway Patrol micro-wave system for this ETV network. This does not mean use of the existing electronic facilities, which are not capable of transmission of a standard television signal, and must be supplemented with additional antennae, transmitters and receivers.

One of the major costs of any micro-wave installation is the survey work necessary to lay out the micro-wave route, and the subsequent development of sites along the route. Site development involves the construction of buildings, towers and roads necessary to install and maintain the micro-wave equipment. Utilization of existing towers and buildings, and the already-surveyed route used by the State Patrol, would lower the cost of a State ETV network by a considerable sum. It would also provide much fuller use of the dollars which already have gone into development of these sites.

WHY SHOULD THE STATE CONSTRUCT ITS OWN MICRO-WAVE FACILITY?

As it becomes necessary to develop micro-wave facilities for ETV in Colorado, one alternative would be to have the Mountain States Telephone and Telegraph Company provide such a facility on a lease basis. As a result of the experience with such a link at the University of Colorado, is is believed that the State of Colorado can provide a better, more reliable system than can the Telephone Company, and at a considerable saving in dollars.

At the present time, the University of Colorado leases micro-wave facilities from the Telephone Company to provide a link between the Boulder campus and the Denver Extension Center. After being used for one semester, it has been seen that such a facility aids considerably in providing quality education at the Extension Center. Subsequently, the lease has been continued for the academic year 1963-1964, and the continuation of a Denver Extension link has been built into the ongoing budget for the Radio-TV Section of the University.

It is possible to measure the quality of transmission between the

University of Colorado TV studio and the Denver Extension Center outlets using TV test equipment owned by the Radio-TV Section. In most cases, where measurements have been made, performance was below that of systems with which CU engineers are familiar.

During the semester, on many occasions, it was necessary to call out the Telephone Company engineers to work on the micro-wave equipment. A total of six outages were logged by Radio-TV technicians during the Spring semester of 1963, and eight outages during Fall semester, 1963-1964. There were numerous other calls made for degraded audio, or video portions of the signal.

It is interesting to note that it is necessary to deal with three separate companies on servicing of our leased facilities. These are the Boulder Mountain States Telephone Company, the Denver Mountain States Telephone Company, and the American Telephone and Telegraph Company. Contacting competent and knowledgeable people in all three check points is a job which takes more time than can be spared when the link goes out at a crucial moment. ETV facilities, as provided by the Telephone Company, are also provided on a non-protected basis, which means that there is no alternative system provided for use in case of outages. Other services also take precedence over ETV micro-wave systems when technical services are needed.

Were the presently leased facilities owned by the University, service would be more quickly provided with a comprehensive program of system maintenance being carried out to prevent any failure of the equipment. The Telephone Company has three licensed people in Boulder who can legally take care of the system. The Radio-TV Section has seven men so licensed on its full and part-time staff of technicians.

The Radio-TV Section's full-time staff engineers have both had experience in micro-wave equipment maintenance and operation. It is apparent that the Radio-TV Section could provide maintenance for a Boulder-Denver system at this time, with present staff.

The present leased system costs the University about $8,500 per academic year. A good figure to base costs of a micro-wave system on is $1,000 per mile. Because of some peculiar problems between Boulder and Denver, a system might cost in the neighborhood of $35,000 to build. By the end of the 1963-1964 academic year, the University will have paid our 33% of the purchase price of such a system to the Telephone Company in leased costs. In regard to maintenance costs -- the state of the micro-wave transmission art is such that on a per-mile basis, these are very low. The equipment is stable and fairly easy to maintain.

Multiply the lack of control, lack of dependability, and high lease cost over a period of years, and the feasibility of a State-owned system becomes quite real. It is interesting to note that Texas owns its own micro-wave system for ETV, and that Illinois is presently contemplating such an owned micro-wave system.

SYSTEM UTILIZATION

In the case of a system like that owned by the Colorado State Patrol, system utilization is measured and the facility justified by the number of messages handled. Because of the complex nature of the TV signal, television micro-wave can only be used for the transmission of the picture and sound associated with the TV program. The micro-wave system we propose would be available 24 hours a day for point-to-point transmission of such material. With installation of video-tape recorders at various points along the network, recording and retransmission can provide very efficient use of network facilities.

COSTS

The following is a very basic list of cost comparisons for various alternatives for the ETV micro-wave systems. Equipment costs are based on list price of RCA TVM-1 equipment. It is quite normal for educational institutions to receive a 5% discount from this figure on such equipment. Should a large amount of equipment be purchased at one time, substantial savings are made through competitive bid.

Costs here are based on utilization of all now-developed sites along a given leg of a micro-wave facility. Further engineering study will probably reveal certain shortcuts that might be taken in order to utilize less equipment and thereby cut the overall system costs:

Phase I:

Cost for one-way closed-circuit service from Boulder to Fort Collins, Greeley and Denver Extension. (Site improvement necessary for Phase I, only.)

Equipment	$ 63,600
Site Improvement	$ 20,000
Maintenance Capital Outlay	$ 6,000
TOTAL PHASE I	$ 89,600
Estimated Telephone Company Lease for Same Service per Year	$ 35,310

Phase Ia:

Cost for two-way closed-circuit service from Boulder to Fort Collins, Greeley and Denver Extension. It is doubtful that such a two-way system between these points will ever be needed. The activation of Channel 12 in Boulder as an educational television broadcast station will provide one-way service, while the micro-wave equipment above will provide the transmission facilities in the second direction.

Equipment	$ 120,000
Site Development	$ 20,000
Maintenance Capital Outlay	$ 6,000
TOTAL PHASE Ia	$ 146,000

Estimated Telephone Company lease for same facility for one year -- $51,360.

Development of a site for use in Phase I would be necessary, as there are no existing sites located to provide the needed service.

The site developed in Phase I could be developed as a multi-purpose facility, and could have a Channel 12 transmitter, as well as relay equipment.

Phase II:

One-way micro-wave facilities to extend the facilities of Phase I to Colorado Springs and Pueblo.

Equipment	$ 82,610
Total Phase II	$ 82,610

If Phase I is carried out properly, it will be possible to utilize now-developed sites for installation of micro-wave equipment for Phase II. Thus, no site development funds are necessary. Implementation of Phase II, utilizing other than now-developed sites, will necessitate expenditure of about $60,000 in addition to the above figure.

Estimated Telephone Company Lease for the Above Facilities------------------------ $ 39,960

Phase IIa:

Two-way micro-wave facilities to extend Phase Ia facilities to Colorado Springs and Pueblo.

Equipment--------------------- $165,000

Total, if Existing Sites Used------------------ $165,000

Estimated Telephone Company Lease for These Facilities------------ $ 58,200

Phase III:

Extension of the facilities outlined under Phases I and II to Durango, via Canon City, Buena Vista and Gunnison. One-way only.

Equipment--------------------- $214,786

Total, if Existing Sites Are Used-------------- $214,786

Additional Funds Necessary to Survey and Develop New Sites---------------------- $200,000

Estimated Telephone Company Lease--------------- $108,570

Phase IV:

Because this Phase is based on conjecture completely, I will not try to estimate these costs. As plans for the total ETV facility of the State become more solid, such a Phase may be estimated.

TOTAL SYSTEM COST SUMMARY

Two-way closed-circuit micro-wave facilities on the Eastern Slope, with distribution facilities to Durango via Canon City, Buena Vista and Gunnison, using existing sites---------------- $ 525,786

Same facilities, using new sites as yet to be surveyed and developed------------------------ $ 785,786

Per-year lease cost estimate to lease these facilities from Mountain States Telephone Company-- $ 267,480

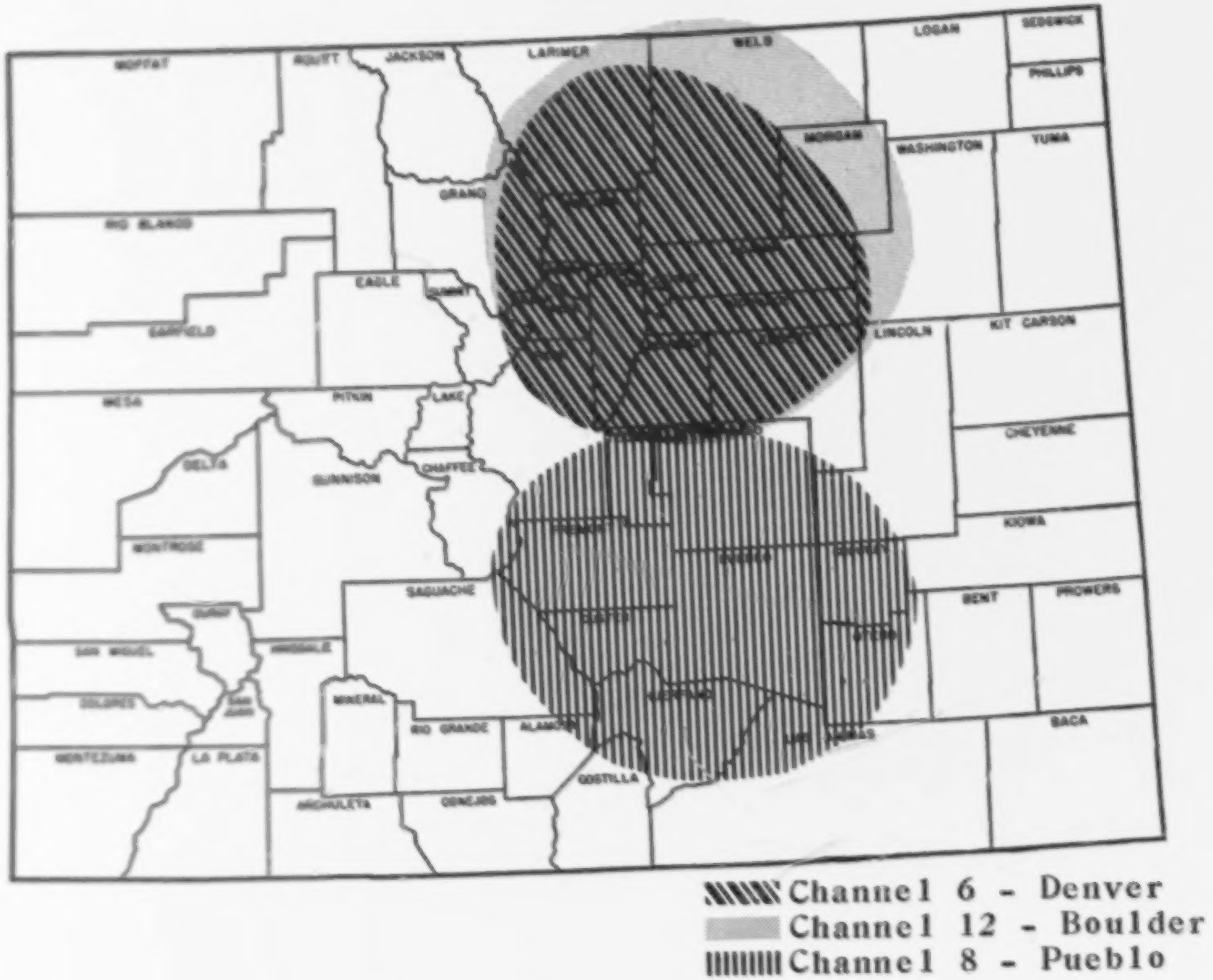
CONCLUSIONS

1. Utilization of existing sites where technically and physically feasible would cut the overall cost of installation of an educational television micro-wave system by between one-third and one-half.
2. Ownership, as opposed to lease, of such a system is an economic advantage, as in most cases, after three years of lease, the State would have expended enough money to construct a facility.
3. Construction of a micro-wave system should be a project undertaken as the need for material increases at various institutions. Certain legs of the system within the outlined Phases might be passed by in initial planning and construction. Such a system

is not to be looked at as a major "all-in-one" expenditure in any short period of time.

4. An educational television micro-wave facility covering the State will provide a great resource to all educational institutions in the State.

APPROXIMATE COVERAGE AREAS OF COLORADO EDUCATIONAL VHF CHANNELS


MOFFAT
ROUTT
JACKSON
LARIMER
WELD
LOGAN
SEDGWICK
PHILLIPS
MORGAN
WASHINGTON
YUMA
GRAND
RIO BLANCO
EAGLE
SUMMIT
GARFIELD
LINCOLN
KIT CARSON
MESA
PITKIN
LAKE
CHEYENNE
DELTA
GUNNISON
CHAFFEE
KIOWA
MONTROSE
SAGUACHE
BENT
PROWERS
OURAY
SAN MIGUEL
HINSDALE
OTERO
DOLORES
SAN JUAN
MINERAL
RIO GRANDE
ALAMOSA
BACA
MONTEZUMA
LA PLATA
COSTILLA
ARCHULETA
CONEJOS
▨ Channel 6 - Denver
▒ Channel 12 - Boulder
▥ Channel 8 - Pueblo

1. ETV-----------Educational Television -- the entire range of television applications to education.

2. ITV-----------Instructional Television -- systematic teaching through the television medium.

3. CCTV----------Closed-Circuit Television -- distribution over lines or micro-wave of television signals to specific reception points.

4. OCTV----------Open-Circuit Television, or "broadcast" -- the transmission of television signals through a transmitter, to all receivers located within a given coverage area of the station.

5. VTR-----------Video-Tape Recorder -- machine which permits storage and re-playing of televised material. There are two general types -- transverse scan and helical scan. Tapes recorded on one type cannot be played on the other.

6. Micro-Wave Link----------electronic link which permits transmitting programs from point-to-point (line-of-sight) without the use of cable.

7. 2,000 Megacycle Band----low-cost transmission method to specific reception points within a small area.

8. Channel 8, Pueblo -- Channel 12, Boulder-------unactivated VHF (Very High Frequency) television channels reserved for educational use in Colorado. Their transmission would be receivable on present television sets. Channel 6 (KRMA) is the only other reserved VHF channel in Colorado.

9. UHF -- Channel 14; Channel 83----UHF channels -- Ultra-High Frequency channels (above the present 2-13 channel spectrum). Many are reserved for education in Colorado. They cannot be received on present sets.

(MORE)

10. NET-----------National Educational Television -- the national programming organization for educational television stations.

11. GPRITL--------Great Plains Regional Instructional Television Library -- an organization for the distribution of courses on tape or film to schools and colleges in a 12-state area, including Colorado.

12. FCC-----------Federal Communications Commission -- Federal agency which licenses all television stations, educational and commercial.

13. HEW-----------Department of Health, Education and Welfare -- the Federal agency responsible for disbursement of funds to ETV stations under the terms of PL 87-447, the Educational Television Facilities Act.

14. MPATI---------Midwest Program on Airborne Television Instruction -- broadcasts ETV programs from an airplane to students in 2,300 schools in six states.

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